AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS, AND BLACKSMITHS.

VOL. 9, No. 45
WEEKLY.

NEW YORK, NOVEMBER 6, 1886.

$2.50 per Annum.
SINGLE COPIES, 5 CENTS.

COPYRIGHT 1886, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Ninety Inch Belpaire Fire Box Boiler.

We present herewith engravings representing a 90-inch Belpaire fire-box boiler designed by E. D. Leavitt, Jr., and built by the Dickson Manufacturing Company for the Calumet and Hecla Mining Company.

The Belpaire type of locomotive boiler is named for its original designer, who is chief engineer of the Belgian State Railways. We are informed that it is the favorite type for locomotives on the continent of Europe, and is making its way into the fast torpedo boats built in England for various governments. On railroads in the United States it is being introduced to some extent, and we believe (according to information received) that the Pennsylvania Railroad Company has adopted this type of boiler for their new Consolidation Locomotives.

The leading feature of the Belpaire design consists in having all plates parallel which are to be stayed to each other, and consequently the outside crown sheet is flat (and usually level) and parallel to the crown sheet of the fire-box, as shown in Figs. 1 and 2. In this type of boiler crown bars are not used, the outer and inner crown sheets being stayed by stay-bolts, which are screwed into both sheets, and further secured by a nut at each end as shown in the illustrations.

The Belpaire boiler has been received with great favor by the consulting engineer of the Calumet and Hecla Mining Company, and has been adopted by this company as their standard form of boiler. Fig. 1 represents a longitudinal section of the boiler, whose smallest course is 90 inches inside diameter. The left hand side of Fig. 2 represents a section through the fire-box looking towards the smoke box end, and the right hand side of the same figure represents a section through the combustion chamber. Fig. 3 shows the spacing of the rivets in the joints of the cylindrical part of the boiler.

In Fig. 3 it will be seen that the circular seams are triple riveted lap joints. The longitudinal seams are butt jointed, each having an outer and an inner covering plate or welt piece. The inner plate is considerably wider than the outer plate, so that the former receives six rows of rivets more than the number of rows passing through the outer welt piece. Altogether, there are ten rows of rivets in each butt joint as shown. Four of these pass through both welt pieces and the main plate, and the other six rows of rivets pass through the inside welt and the main plate. The distance between centers of rivets in the four outer rows is $11\frac{1}{2}$ inches, in the next two rows it is $5\frac{3}{4}$ inches, and in the four central rows the pitch of rivets is $2\frac{7}{8}$ inches.

This butt joint is of a form peculiar to Mr. Leavitt's practice, and and he claims that the testing machine shows this form of butt joint to be capable of resisting fully 93 per cent. of the capacity of the solid plate.

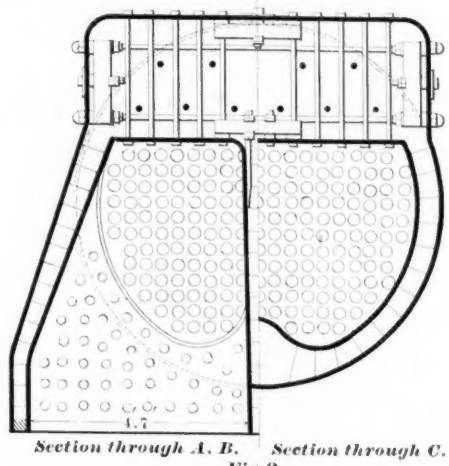
In order to obtain a space large enough to allow a man to pass over the whole length of crown sheets, the transverse rods had to be placed far enough apart, and consequently side bars had to be used for the purpose of thoroughly supporting the sides of the outer fire-box. For the same reason similar bars are used for bracing the longitudinal central part of the outer crown sheet. The longitudinal and transverse tie-rods pass through the plates and have cast steel cap nuts on the outside. The combustion chamber lower plate is so bent as to allow a man to pass under the combustion chamber as far as the fire-box.

The feed water is taken in at the top and passes through a pipe of sufficient length to heat the water to a very high temperature before it is distributed along the sides. The steam is taken through slotted pipes at the top of the boiler.

All rivet holes are punched $\frac{1}{16}$ of an inch smaller in diameter than the diameter of the rivets, and when the plates are in proper position the holes are then reamed to a size of $\frac{1}{16}$ of an inch larger in diameter than that of the rivets.

The plates in the cylindrical part of the boiler pass completely around and the joints are kept above the water line wherever possible. These plates are about 24 feet long by 6 or 7 feet wide, the widest weighing upwards of 4,000 pounds.

All plates are of open-hearth steel and have an elastic limit of not less than 37,000 pounds per square inch, an ultimate strength of not less than 53,000 pounds, or more than 61,000 pounds per square inch and an elongation of not less than 20 per cent. in 15 inches.



Section through A. B. *Section through C. D.*

Fig.2

NINETY INCH BELPAIRE FIRE BOX BOILER.

TABLE OF HEATING SURFACES.

Fire-box	326.8	square feet.
Flues	90.4	" "
Combustion Chamber	94.3	" "
Tubes	2,319.8	square feet.
Back Tube Sheet	34.4	" "
Total Heating Surface	2,865.7	
Grate Area	64.17	square feet.

Ratio of grate area to heating surface 1 to 44.64.

Area of cross section of inside of tubes (calorimeter) 8.4 square feet.

Ratio of grate area to calorimeter, 7.64 to 1.

Ratio of cross section of smoke pipe to grate area 1 to 6.

Those in the boiler trade who have placed boilers at Syracuse have generally found out what the manufacturers there take as a matter of course; that is that the water is impregnated with about everything not wanted in a boiler which that universal solvent, water, will hold in solution. Sweet's Manufacturing Company, of that city, use a large number of boilers, and having the usual trouble with dirt and scale, are at present engaged in solving the problem of how to get better water. They have sunk a half dozen wells, but the quality of the water obtained is not satisfactory, so they will put in surface condensers with independent air pumps. It is thought the water may be better after pumping from the wells for some time. When the work is all done they will have very complete water works of their own.

At the above named works a large business is done in working up old steel rails, which are split up in rolls, then rolled to shapes and worked up into a large variety of articles. In most manufacturing there is a considerable waste of material in the way of odds and ends that cannot be used, and which brings but little when sold, but manufacturing from old rails seems, in this instance, to be an exception. The articles that are made from the different parts of the rail—after splitting and rolling, and in some cases carbonizing—are so nicely graded to the stock that the waste is all in small pieces that bring a price per pound considerably above the price of old rails. The waste is to all intents a manu-

factured product, which if it does not pay a profit as a manufactured article, still pays something towards putting it into shape.

These pieces are used in making some qualities of steel, and are wanted in small sizes. If in large sizes they would not be suitable for that purpose, hence there is a double incentive to keep the waste low. If the pieces were large they would require further manufacturing—that is cutting up—before they would bring the present price. It would not pay to manufacture "waste" of the entire rail, but it does pay in two ways to make just such articles from a rail as there is stock for, wasting pieces always within a certain limit as to size.

Practical Drawing.

By J. G. A. Meyer.

THIRD PAPER.

28. A plane figure is a portion of a plane bounded by lines either straight or curved.

29. A circle is a plane figure bounded by a curved line, every point of which is equally distant from a point within, called the center.

The bounding line is called the circumference.

30. A radius is a straight line drawn from the center to any point of the circumference, as $C\ A$, Fig. 5.

A diameter is a straight line drawn through the center and terminating in the circumference, as $B\ D$, Fig. 5.

31. An arc of a circle is any portion of its circumference, as $A\ C\ B$, Fig. 6.

A chord of an arc is the straight line which joins its two extremities, as $A\ B$, Fig. 6. A segment of a circle is the figure included between an arc and its chord, or, we can say a segment is a part of a circle included between an arc and its chord. See Fig. 6.

32. If the arc of a segment is equal to half the circumference of a circle, its chord will then be equal to the diameter of the circle and such a figure is called a semi circle, as $A\ B\ C$, Fig. 7.

33. By the term "segment" a portion of a circle less than a semi-circle is always understood, unless the contrary is expressed.

34. A sector is a part of a circle included by an arc and the two radii drawn to its extremities, as $A\ B\ C$, Fig. 8.

35. When two straight lines meet together, as $A\ C$ and $B\ C$, Fig. 9, their mutual inclination or degree of opening is called an angle. The point C, in which the straight lines meet, is called the vertex of the angle, and the lines are called the sides of the angle. If there is only one angle at a point it may be denoted by a letter placed at the vertex, as the angle at C, Fig. 9.

But when several angles are formed at the same point by different lines, either of the angles may be denoted by three letters, namely, by one letter on each of its sides, together with one at its vertex, which must always be written between the other two. Thus the lines $A\ B$ and $C\ D$, Fig. 10, form two different angles, which are distinguished as $A\ C\ D$ and $B\ C\ D$.

36. When one straight line meets another the two angles which they form are called adjacent angles. Thus, the angles $A\ C\ D$ and $B\ C\ D$, Fig 10, are adjacent.

37. The size or magnitude of an angle does not depend upon the length of its sides.

Angles are measured by degrees. If a circumference of a circle is divided into 360 equal parts, each part is called a degree. If a degree is divided into 60 equal parts, each part is called a minute, and $\frac{1}{60}$th part of a minute is called a second.

Let the straight line $A\ C$, Fig. 11, meet the straight line $B\ D$ in the point C. With this point C as a center, describe a circle of any radius. If then the line $A\ C$ divides the semicircle $B\ A\ D$ into two equal parts, so that the arc $A\ B$ will be equal to the arc $A\ D$, the angle $B\ C\ A$ will be equal to the angle $A\ C\ D$. Now, if we commence at B and divide the circumference of the circle into 360 equal parts, the arc $B\ A$ will contain 90 of these parts, and the angle $B\ C\ A$ is said to measure 90 degrees. The arc $A\ D$ will also contain

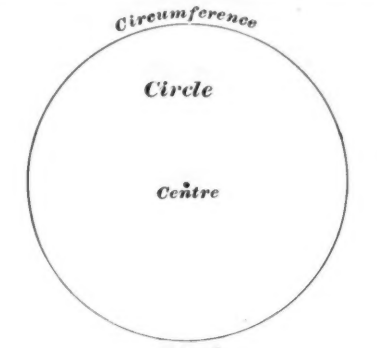


Fig. 4

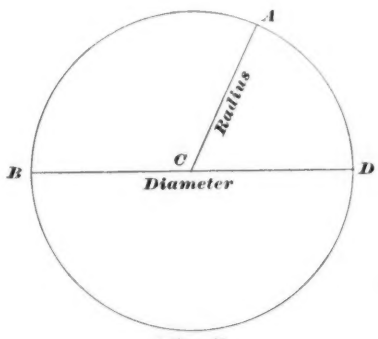


Fig. 5

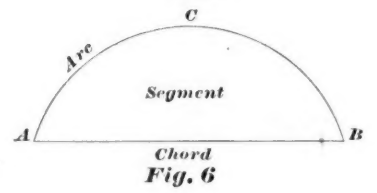


Fig. 6

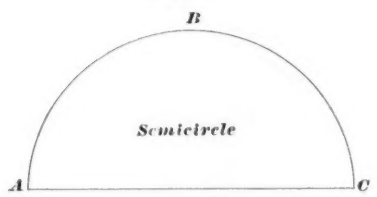


Fig. 7

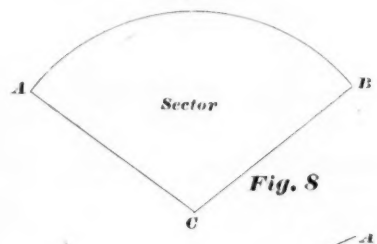


Fig. 8

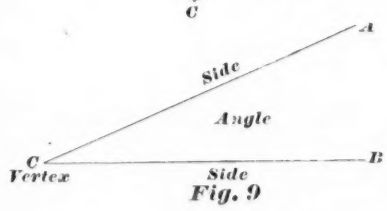


Fig. 9

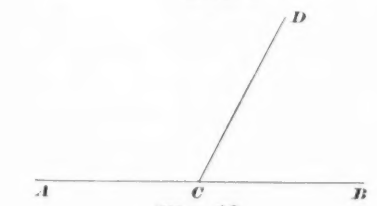


Fig. 10

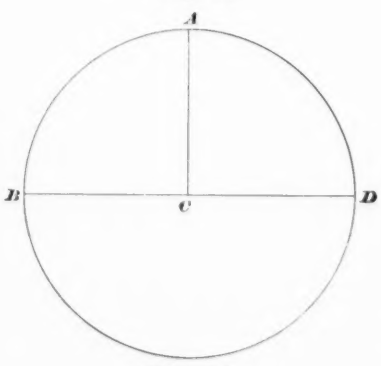


Fig. 11

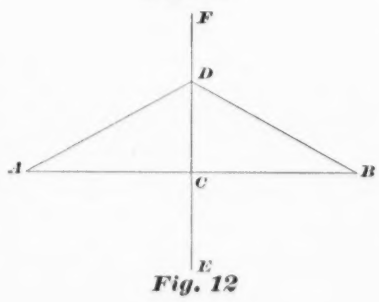


Fig. 12

90 parts, and hence, the angle $A\ C\ D$ also measures 90 degrees.

38. A right angle is formed by one straight line meeting another so as to make the adjacent angles equal. The first line is then said to be perpendicular to the second. By referring to Fig. 11 we see that the straight line $A\ C$ is perpendicular to the line $B\ D$, because the adjacent angles are equal. The angles $B\ C\ A$ and $A\ C\ D$ are called right angles, and each measures 90 degrees.

39. We can easily determine whether a line is, or is not, perpendicular to another line.

Let $A\ B$, Fig. 12, be a given straight line, and $E\ F$ the perpendicular, intersecting the line $A\ B$ in the point C. On the line $A\ B$ mark off any point as A; from the point C on the same line, and with the distance $A\ C$,, lay off the point B. Then will any point of the line $E\ F$ be equally distant from A and B. Thus, from any point of $E\ F$, as D, draw the lines $D\ A$ and $D\ B$. Then will the lines $D\ A$ and $D\ B$ be equal; hence the point D is equally distant from A and B.

But if the line $E\ F$ is not perpendicular to the line $A\ B$, then the lines $D\ A$ and $D\ B$ will not be equal; and therefore the point D is not equally distant from A and B.

40. Again, if a straight line $E\ F$ (Fig. 12) have two of its points, E and F, equally distant from A and B, it will be perpendicular to the line $A\ B$ at its middle point.

41. When lines are not perpendicular to each other, we can determine the amount of

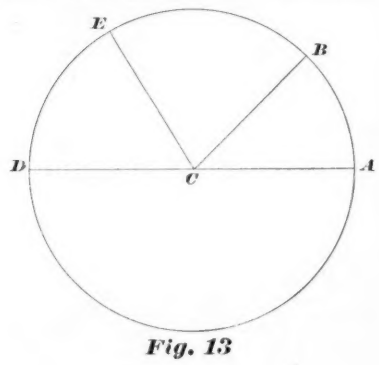


Fig. 13

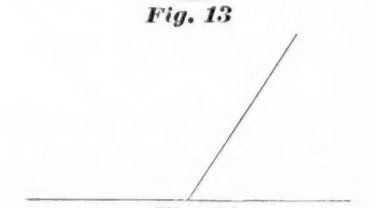


Fig. 14

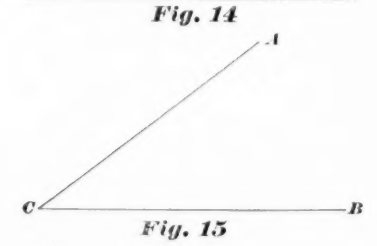


Fig. 15

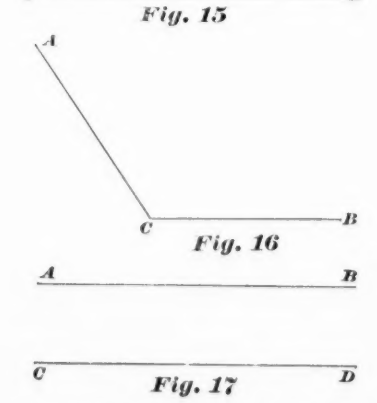


Fig. 16 Fig. 17

mutual inclination by measuring the angle formed by these lines. For instance, let $C\ A$ and $C\ B$, Fig. 13, be two straight lines, not perpendicular to each other. From the point of intersection C draw a circle with any radius; then, if the arc $A\ B$ is one-eighth of the whole circumference of the circle, the angle will measure 45 degrees, and the lines are said to have an inclination with each other of 45 degrees. Or, again, take the lines $C\ D$ and $C\ E$; if the arc $D\ E$ between these lines is one-sixth of the whole circumference, the angle $D\ C\ E$ will contain 60 degrees, and the lines are said to have an inclination with each other of 60 degrees.*

*Special instruments are made, with which we can find the number of degrees contained in any angle. These instruments will be explained hereafter.

42. An angle, as $B\ C\ A$, Fig. 13, whose vertex is at the center of a circle, is called an angle at the center.

Equal angles at the center, in the same circle, or equal circles, are subtended by equal arcs.

43. An oblique angle is formed by one straight line meeting another, so as to make the adjacent angles unequal, see Fig. 14. Oblique angles are subdivided into two classes—acute angles and obtuse angles.

44. An acute angle is less than a right angle, as $A\ C\ B$, Fig. 15.

45. An obtuse angle is greater than a right angle, as $A\ C\ B$, Fig. 16.

46. Two straight lines are parallel when they lie in the same plane, and cannot meet, how far soever either way both may be produced, as $A\ B$ and $C\ D$, Fig. 17. They then have the same direction.

The highest chimney yet built in the world has recently been completed at the Mechernich Lead Works in Germany. The whole height of the structure is approximately 440 feet, 11 feet of which is under ground. The subterranean portion is of block stone, 37 feet square in plan; all the rest is of brick. For about 34 feet the chimney continues square, then becomes octagonal in plan for a little distance, and finally changes to a circular form, retaining this shape to the top. The exterior diameter of the shaft at the top is about 11½ feet. The flue is 11½ feet in diameter at the bottom and 10 feet at the top.

Improving the Water Supply of a City.

The enterprising manufacturers and business men of Syracuse, N. Y., are taking somewhat unusual, but what bids fair to be effective means to improve the water supply of that city, which it may be stated is at present phenomenally poor as to quality. Some 37 miles away from the city, over a very feasible route, is the Salmon river, from which it is proposed to take the supply. When dammed this will give a head of between 500 feet and 600 feet, so that a reservoir can be located on the hill near Syracuse. In order to give the citizens an opportunity to see what good water is really like, the before mentioned manufacturers and business men are giving the people free excursions to the Salmon river, from which they return with bottles and jugs filled with the—to them—precious fluid. There are more excursions to come, and as the excursionists unanimously vote the plan just the thing, and the water A1, which it undoubtedly is, there seems to be no reason for doubting the ultimate success of the scheme. All that is necessary will be to persuade a majority of the citizens to accept the hospitality of those who are interesting themselves in the movement; whatever their opinions when starting, they are invariably advocates of the plan as soon as they have been at home long enough to sample the present supply. It is only by request that we do not mention the name of the leading spirit in this move, who, we are proud to say is a well-known manufacturer. We have often spoken of the value to a city, in a manufacturing point of view, of a plentiful supply of good water, and Syracuse is fortunate in having so good an opportunity to obtain it. The necessary outlay would, from all appearances, be better than an investment at ten per cent.

We notice more and more of a tendency every year to make things whole rather than in parts. An example of this at the shop of C. E. Lips, at Syracuse, is quite noticable. Amongst other machines he makes is an extremely ingenious one for sewing brooms. This machine has numerous projecting parts—bearings for shafts, arms, etc. Formerly these were fitted and bolted to the main frame, forming no inconsiderable part of the work of manufacturing the machine. Now all this is changed, and all these protruding parts are cast in one piece with the bed. The machine, we should say, was from three to four feet—perhaps more—in height, and there is considerable machine work to be done on these projecting parts. To do this he has constructed a milling machine so that

the machine under construction will stand on the base, and the milling tools can be brought to operate on all the parts required.

There are but few shops where, in proportion to size, as much use is made of the milling machine as at this one. So far as required for the work done, the system of gang cutters seems to have been brought very near perfection. Milling is done because it pays to do it.

Machine Tools for Pattern-Makers.

BY F. W. BARROWS.

I have seen a saw table, made of seven-eighths matched spruce, with the hole where the saw came through so large that it wouldn't be safe to saw anything less than a foot square, for fear that it would fall through the hole, but this wasn't a table for nice work, as anyone could see. I remember another saw-table, also made of wood, where I sawed some curly maple veneers $6\frac{1}{2}''$ wide and only $\frac{1}{16}''$ thick, with an ordinary 16″ or 18″ saw, and they didn't go down through the table either. This saw, which I am pretty sure was filed square across, was located in Colt's armory pattern shop, at Hartford, Conn., and with other saws for the same table were the best cutting saws I ever used.

The iron saw-table of to-day is a marvel of convenience, compactness, and durability, and with the different attachments will do a great variety of work, and do it nicely.

Did you ever have any trouble in setting the fence or guide, on an old-fashioned (and some new-fashioned) saw-table to saw to an exact width? After measuring closely the distance between saw and fence, you turn down the clamp-screw, and move the fence forward or back a little. Try it again and this time hold on to the fence. There now it is all right, sure you have got it clamped tight. You try it and find that it isn't tight, and give the screw another turn, with the same result as the first trial. By this time you are getting tired and long for a chance to get even with that fence. Then you took a hammer, and tried by rapping it lightly, to correct the error, but it didn't move readily, and you got excited over it; perhaps you broke something.

How much better the fence on the iron table works, especially those having a quick and slow motion. Make a gauge line on a piece of stuff just where you want the inside of saw to cut. Set the fence by the quick motion, nearly to this line, start the saw, and by the slow motion move the fence up until the saw split the line. Your success will now depend upon the steadiness with which the saw runs, and your skill in feeding the stuff up to the saw.

Another bad feature about a wooden table is the wear. The fence gets rounding and out of square, the table wears down into a hollow, which is lowest just in front of saw, and the hole where the saw comes through table will wear off on each side of the saw, especially the top corners. This leaves it in a bad state for doing any small work. To offset this, the iron table is a little apt to be sticky like an iron plane, and does not keep as clean as a good hard-wood table.

Fig. 61 will illustrate two ways of roughing out small core-boxes on the buzz-saw. I have heard it asserted that it was possible to cut a small core-box for a straight round core, exactly to the finished size, but I will show you why this can't be done, by referring to Fig. 61.

Suppose we wish to saw a box, the diameter of which is equal to the space between lines *f g* and *i h*. Let the line *a b* be the top of saw-table; set the saw to the right height, or one-half the diameter of the core-box. A part of the saw, represented by the arc *d e*, is now above the saw-table. We must now find the angle at which the box must be passed over the table, that the saw, which has been adjusted to the correct height, may also be made to cut to the right width. It is evident that a line representing the chord of an arc *d e* made by the points of teeth on saw, which chord will be at the surface of table, when drawn on the core-box, is placed in such a position that one end touches line *i h*, while the other end touches line *f g*, will show the angle at which the box must pass over the saw.

When the angle is small, as in the present case, allowance should be made for the thickness of saw.

Now by making a diagram similar to Fig. 61 we will be able to see just what shape the core-box will be in after passing over the saw. Draw lines *j k l* from *a b*, the top of table, to arc of circle *d e*, and perpendicular to *a b*, then from the points where these lines meet with *a b* draw other lines *o p q* at the same angle with *a b;* that we found would be necessary to make the saw cut to the right width; draw a line *r s* at right angles with *o p q;* this line will represent the face or joint of core-box. Now measure on lines *j k l* the distance between *a b* and arc *d e*, transfer each of these spaces to lines *o p q*, measuring this time from line *r s* and keeping the spaces the same on similar lines; that is, make the space on line *q* the same, measuring from *r s*, as the space between *a b* and *d e* measured on line *j*. After transferring all the spaces in the same way connect the points found on lines *o p q*, and the result will be a curved line *t u v*. I have shown only a part of the whole curve, but enough is shown to enable you to see that a section of the box instead of being a true circle would vary therefrom in proportion as the diameter of saw varies from the diameter of core-box. The nearer the two are of the same diameter the closer we shall be able to cut the box. If it were possible to use one-half of the whole saw, and move the box exactly square across the saw, we should be able to cut out a half circle having the same radius as the saw, but this would not be possible with the ordinary saw-table, therefore it isn't likely that anyone will cut round core-boxes exactly to the line in this manner.

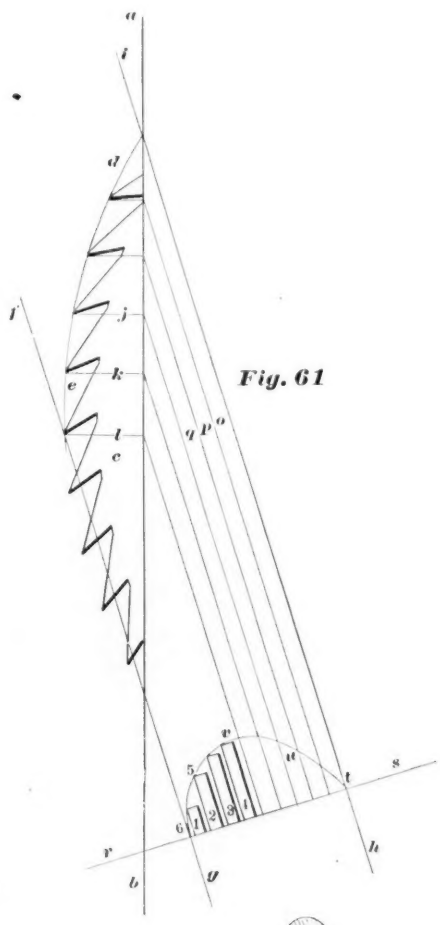


Fig. 61

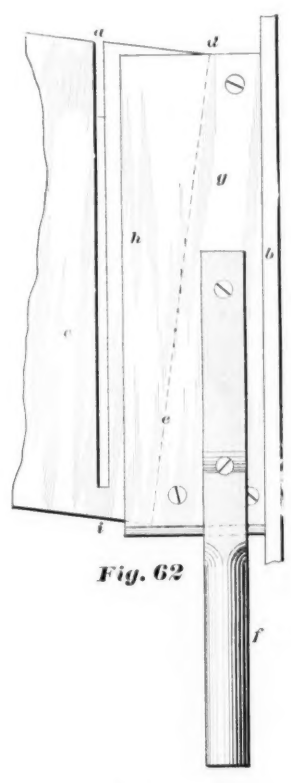


Fig. 62

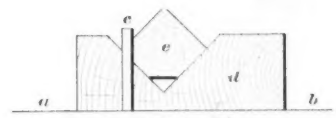


Fig. 64

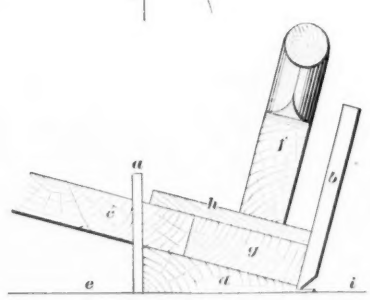


Fig. 65

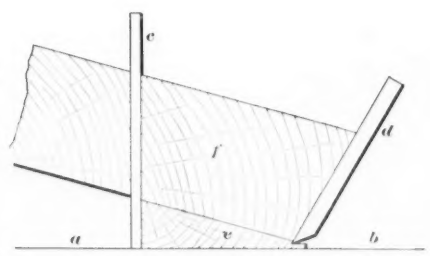


Fig. 63

Staves may be hollowed out in this way very nicely and rapidly. For this purpose you want a keen saw, and one that is very stiff.

A better way of roughing out core-boxes is also shown in Fig. 61, where *v* 5, 6 is the circle of box, and 1, 2, 3, 4 show grooves sawn lengthwise through the box, and of such depth as will just reach the line *v* 5, 6. I have shown thin strips of wood left between the saw-kerfs, but the cuts may be made close together or even overlapping near the sides of box so as to remove more of the wood shown above groove marked 1.

Fig. 62 shows a very common way of sawing wedges. The gauge is made with one side shown by dotted line having the required taper. Place the opposite side against the fence *b*, hold one edge of the piece to be cut against the templet, letting the end towards you rest against the shoulder formed by the piece *i*, which is fastened to the back end of templet, then by moving the stuff over the saw while it is held against the templet, which in turn is guided by the fence, you will be able to saw any number of wedges all alike, and having the same taper as templet *g*. You may facilitate matters a little by putting a handle on the templet as shown at *f*, and by making the templet of the same thickness as the stuff to be sawed, and putting a piece on top, as shown by *h*, reaching nearly to the saw, you will prevent any piece being caught and thrown back by the saw.

If you wish to cut the wedges to a point, reverse the templet and put the handle and the piece *i* at the opposite end.

Fig. 63 shows a way of sawing up staves which waste no lumber. *a b* is the top of table, *c* is the saw, and *e* the templet or gauge piece used. This piece is made with the angle at upper corner next the saw, the same as the required angle for staves, and the edge under fence *d* is sawn to a parallel thickness, as shown; or you may cut a shallow groove in the upper surface of this piece, the idea being to make provision for its being held in position by the lower edge of tilting fence, which is beveled off nearly to an edge in order to keep the face close down to the table when the fence is tilted, as shown by *d* in the present case.

If the stuff is to be cut to the required length, then saw one stave off each piece, a little wider than the finished stave, then you tilt the fence until it fits the beveled edge as shown at *d*, and move it up to the right distance from saw. Now, by turning over the stuff each time a stave is cut off, you cut the staves all to a width and bevel both edges at one operation.

By a combination of the principles shown in Figs. 62 and 63, a dovetailed wedge may be sawn as shown in Fig. 65, where *e i* is the table, *a* the saw, *b* the fence, and *c* the stuff to be cut, *d* is the beveled piece which forms the dovetail, *g* the wedge-shaped piece which gives the proper taper, *f* the handle, which is also shown in Fig. 62, at *f*, *h* is a piece put on top of *g*, and projecting over the piece to be sawed—the same as *h* in Fig. 62. The stuff is to be turned over every time a wedge is cut off. Thus you see they will be cut on the right taper, and both edges beveled at one operation. The dovetails for gear teeth may be cut in this way, or the dovetails for holding loose pieces in place may be cut.

With the aid of the tilting fence you may saw ordinary sized work so that the section shall have any form that is bounded by straight lines, but very small pieces cannot be sawed in this way, for lack of sufficient surface to steady them against the guide. In Fig. 64 I have shown a way of sawing small pieces to an octagonal form. The piece *d* has a groove cut in its upper surface, the two sides of which form an angle of 45° with the surface of saw-table *a b*. To set this in place, if the saw is raised and lowered by a screw, or in any other way that will admit of moving the saw while in motion, lower the saw below the surface of table, then place the piece *d* in its place, and fasten it in any convenient manner; then start the saw and raise it while in motion, letting it cut a passage for itself through *d*, and raising it only just high enough to cut through the stuff. You can now cut any number of pieces to the same size and shape. The piece must have a parallel thickness and one square edge.

Although I have shown the gauge *d* made to cut octagons, it is evident that the same principle may be applied to any required angle. With the gauge as shown in 64, but with the saw coming up through the center of groove, you can cut any amount of fillets, and with the saw as shown you can saw dowel pins, and with the help of a dowel plate (a piece of iron or steel with a hole through it the size you wish to make pins) you can finish them ready for use, taking them as they come from the saw and driving them through dowel plate, will shape them ready for the pattern.

A prominent Detroit man says a $300,000 exposition building will be built there before the June roses bloom again. Some day there may be a movement towards erecting an exhibition building in New York city.

With Best Wishes.

(From the *Manufacturers Review and Industrial Record.*)

"We learn from the issue of October 16 of our esteemed exchange, the AMERICAN MACHINIST, that it has secured the services of Mr. J. G. A. Meyer, a distinguished author on engineering, who will hereafter devote himself to work in the editorial department of the paper. Mr. Meyer is an experienced mechanical engineer, and is familiar with both railroad and other mechanical appliances. He was with Mr. McClellan four years, while the latter was superintendent of the docks in this city. For some time he was engaged in Roach's shipbuilding establishment, and during the last ten years has been chief draughtsman and designer at the Grant Locomotive Works, a position which he resigned to accept this new one. We heartily congratulate our contemporary on this valuable acquisition to its editorial staff."

A woman works in a Kalamazoo cooper shop, and she can make as many barrels as any man in the shop working ten hours a day. —*Grand Rapids Telegram-Herald.*

Rolling Conic Sections Applied to Circular, Elliptic, Parabolic, and Hyperbolic Gears.

By GEORGE B. GRANT, BOSTON.

The utility of the conic sections, used as the pitch lines of gear wheels, lies in the fact that under certain conditions they will roll together in perfect rolling contact when mounted upon fixed centers.

We can put all the conic sections under one law as to each of several features when rolling together, as follows:

Any two equal conic sections will roll together in perfect rolling contact when fixed on centers at their opposite foci.

Their moving foci will move at a fixed distance apart.

The two curves will make a continuous and complete revolution on each other.

The point of contact of the two curves will be at the intersection of the line of the fixed foci with the line of the moving foci.

The common tangent to the two curves at their point of contact will pass through the point of intersection of the two axes.

There are four conic sections, varying only as to their focal distance. The circle, having a focal distance of zero, the ellipse, having a finite and positive focal distance, the parabola, having an infinite focal distance, and the hyperbola, having a negative and finite focal distance.

Any two curves that will roll together may be used as the pitch lines of gear wheels, and therefore we can have gears with either circular, elliptic, parabolic, or hyperbolic pitch lines.

In either case the moving foci may be connected by a link that will hold the two gears together when in motion, and this link will act in the most direct and advantageous manner when most needed, when the action of the teeth becomes so oblique as to be of little service.

The four cases are illustrated by the four figures:

Case I.—When the focal distance is zero the curves are circles, as in Fig. 1. The link is here simply a fixed bar connecting the two centers, for the two foci are combined in one point at the center.

Case II.—When the focal distance is positive and finite, the curves are ellipses that will roll together if fixed on centers at their opposite foci, as in Fig 2. The link is a moving bar connecting the two moving foci.

Case III.—When the focal distance is infinite, the curves are parabolas, but the principle of their action is not changed. One parabola turns about its focus while the other turns about its opposite focus, but as the opposite focus is at an infinite distance, the second parabola must move in a straight line at right angles to the line of centers, as in Fig. 3. The link becomes a bar of infinite length, and cannot be practically applied. The revolution is complete, but of infinite extent, so that it cannot be practically accomplished.

Case IV.—When the focal distance is finite but negative, the curves are hyperbolas, but their action still follows the same law. The opposite focus about which one hyperbola turns, is now on the other side of the curve, which becomes a negative or internal pitch line, as in Fig. 4. The link is of finite length and can be practically applied. The revolution is complete, for, as soon as one pair of curves separate, the other pair come together, and the motion is continued.

The utility of circular gears is universal, and elliptic gears have many applications, but no use is apparent for parabolic or hyperbolic gears. A use for them will probably be found when their existence and properties become well known, and they are certainly of interest to the student of mechanism.

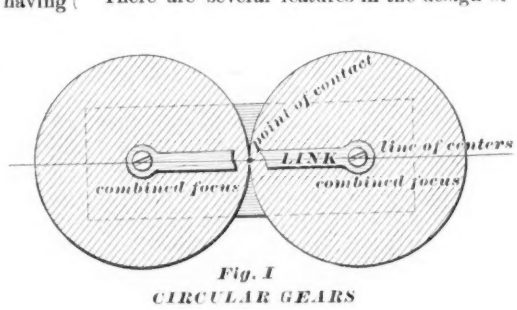


Fig. I
CIRCULAR GEARS

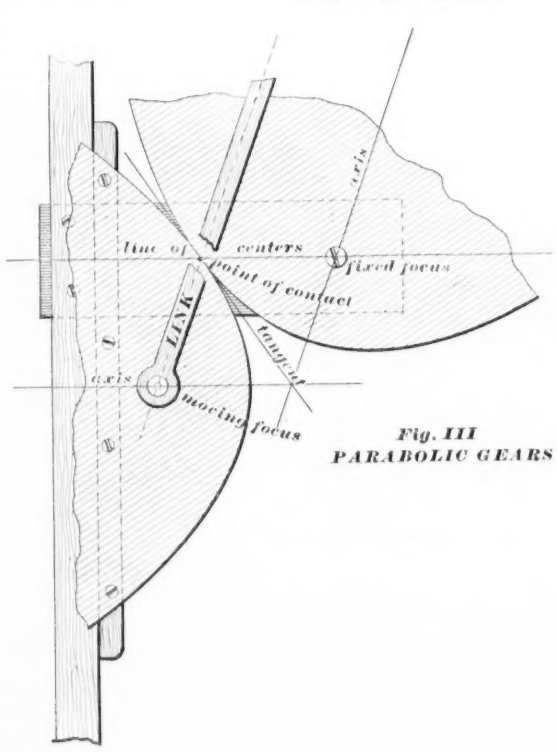


Fig. III
PARABOLIC GEARS

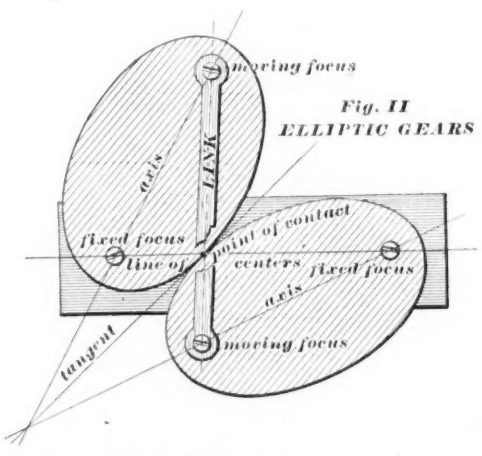


Fig. II
ELLIPTIC GEARS

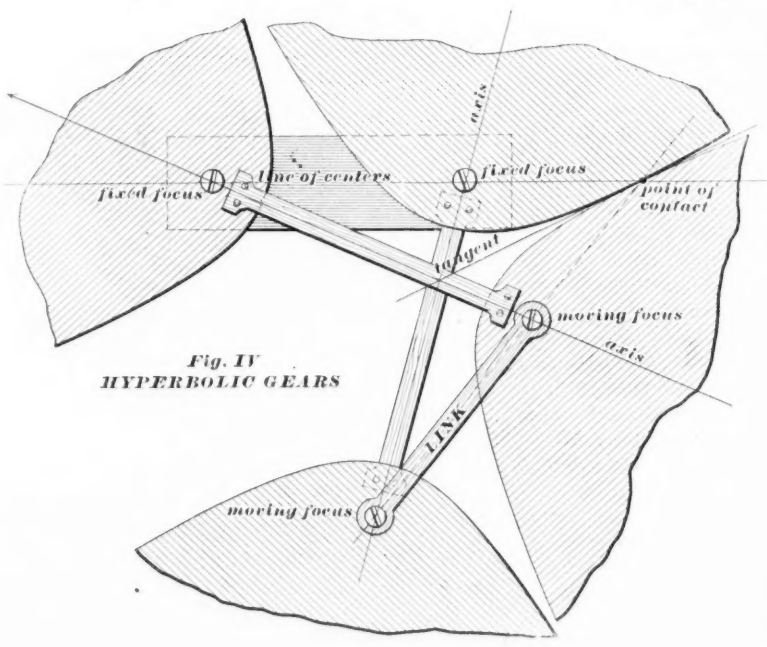


Fig. IV
HYPERBOLIC GEARS

At the Straight Line Engine Works.

Some time since we noted that Professor Sweet, Superintendent of the Straight Line Engine Works, was building a large milling machine, or as he terms it, a rotary planer. We recently saw this machine in process of construction. In its general features the machine resembles an ordinary planing machine, the platen moving on the bed to give the feed in one direction, a "cross head" giving transverse feed. The platen is 3 feet wide, and, we believe, 10 feet in length, yet so heavily proportioned is the machine that it will weigh 10 tons. It is expected that the new machine will be used for a large share of the engine work now done on planers.

There are several features in the design of this machine that are deserving the attention of machine tool builders. The bed is of rectangular section, top, bottom and sides being closed. This certainly gives great strength to resist distortion by twisting. The uprights, or housings, quite similar to the corresponding parts of an ordinary planer, are also cast hollow, to secure breadth and strength. The platen, like the bed, is hollow, and of rectangular section. In addition to securing strength in proportion to the metal used, it is also believed that a platen made in this way will be much less likely to be sprung in bolting work to it. The bearings or wearing surfaces of the table are flatways—it will be recollected that the platen moves only for feeding—and in addition to its weight it is securely gibbed to the bed. Both horizontal and transverse feeds may be used at the same time, the resulting motion being at an angle of 45°. In moving the cross-head by hand, as in coming up to the cut, it is not necessary to go to the outside of the upright, the screw being stationary and motion obtained by revolving the nut, which is close by the work and can be reached by the operator without moving out of his natural place, that is, with his eye on the cutter and the work.

Several special machines and appliances for manufacturing steam engines have been added to the plant. One machine for doing all the boring required about the cylinder and bed (it will be remembered that the cylinder is cast in one piece with the frame) at one operation, appears to be a very effective tool. Placed on the machine the work finds the correct position, when two bars—one horizontal and the other transverse—working at the same time, bore, the one the cylinder, etc., and the other the seats for the main pillow blocks. Change of feed is accomplished by changing feed-screws and nuts, these being arranged so that the change is made practically without loss of time. One of the boring bars is driven by worm gearing, the other by spur gearing.

At present the plain machine work on cylinders and frames is done on a planer (eventually it will be done on the rotary machine). In planing, the cylinder end is mounted in a saddle plate, and the crank end on a center. A templet on the platen gives all sizes to plane to without occasion for measuring. At first both ends were mounted on centers, and although the templet was an invariable gauge by which to set the tool, the vertical measurements to planed surfaces on no two engines were alike. It was soon discovered that in setting up the centers to the work the planer platen was sprung up at the center of its length, and of course was never sprung twice alike unless by accident. And the extent of this springing was much greater than seemed probable, or possible, under the circumstances. This led to the use of a saddle at one end in place of the center, and remedied the trouble.

The experience on this job leads to the suggestion that springing planer platens in this way, or by ill-considered clamping of work, may be responsible for a good deal of the cutting of planer Vs so generally observed. Either of two causes might do the mischief; the weight might all be thrown on two points, resulting in cutting these, or where the bearing surfaces were separated fine dirt might find its way between them, with similar results at that point.

We noticed at the works that the cylinder heads to all the engines are put up without scraping or grinding the joints, although no packing of any kind is used. Upon inquiry we found that the fact had been developed that a better joint was assured—in fact, a perfect one every time—when the surfaces were left just as they came from the lathe. The small, regular projections left by the tool—for we observed that no attempt was made to do an especially smooth job of facing—seem to be just what are wanted for making a tight job, metal to metal. We thought of the—apparently—useless work we had done surfacing joints between cylinders and heads for the purpose of making a job not quite so good as if this work had been omitted.

On all the engines built the connection between piston and cross-head is made by means of a screw thread. The lead is fine, we believe in all sizes 16 threads to the inch. Complaint is sometimes made that threaded rods break in the thread, but none of their rods have ever been broken, notwithstanding the fact that two sides of the thread are cut away by slabbing clear across, so that a little less than one-quarter of the circumference of the thread is left at the top, and the same at the bottom. By doing this, and by correspondingly cutting the thread out of the crosshead, a quarter turn of the rod releases it so that it may be pulled directly out of the cross-head. Turning the rod one-half around lengthens or shortens the distance between piston and cross-head $\frac{1}{32}$ inch, which is fine enough for all practical purposes. With reference to the breaking of rods in the thread we think the jamb-nut ordinarily used may have considerable to do with it. In this case the cross-head being divided and pinching bolts used, no jamb nut is required, while the pinching bolts passing close to the slabbed sides of thread effectually guard against the possibility of the rod turning around. It should be observed that the slabbed or flattened part of the rod does not terminate with the thread, but extends some little distance on the round of the rod and then ends in a rounded corner, leaving no place for the rod to begin to break. In tapping the crossheads for the threaded end of the rod the tap will not, of itself, "lead" correctly; a master nut has to be used for this purpose. This nut is made exactly the length of the guiding thread on the shank of the tap. So the wear will always be equal, thereby preserving the lead indefinitely. The tap proper consists of only one section or set of teeth, 12 in number, made so that the first teeth will cut a narrow space, those that follow gradually widening it. The cross-head is tapped in a jig, which insures absolute accuracy of alignment. In fact, jigs are used for about everything possible, and so far as practicable they are so constructed that if the previous work on a job is wrong the jig will detect it, in other words the jig cannot be used.

In connection with jigs we noticed that when a rod of standard diameter is to form part or all of the guide, a rectangular slot is substituted for the proverbial V. The sides of the slot, and the flat bottom, are a safer guide than the V.

We believe no attempt is made at the scientific counterbalancing of engines. All engines are set up and run for a considerable length of time, both light and under brake power to their full capacity. At first they are bolted fast to the foundation plate, the

presumed proper counter-weighting being done. Eventually the straps that hold the engine down are loosened, and counter-weight added or taken away until there is no inclination to endlong motion. It is then known to be in balance for the speed at which it is run, without reference to whether ten pounds more or less counter-weights are used. The above at least was the plan we saw pursued with an engine under test to run at 260 revolutions.

A record is kept of every engine sold, so that duplicate parts can be furnished at any time or correct action given as to changing speed. For this purpose the following blank is filled out, from which the final record is made:

THE STRAIGHT LINE ENGINE CO.

Report on engine No..... Size.....
Set up and tested by.....
Completed.....188 Shipped 188
sold to.....
Set to run.....Revolutions light.
.....Revolutions loaded.

Size of seats for main boxes.....
Number of leaves in spring..... .....Spring.
Size of cylinder..... Weight of shot in ball .....
Size of main bearings..... Pulley bearings .....
Thickness of valve..... Height of lower strap.....
Length of valve ..... Length of piston.....
Thickness of crosshead ... Length of piston rod....
Clearance at each end.. Length of piston rod bush..
Distances between centers, eccentric strap and rod.....
Length valve rod..... Length conn. rod.....
Length valve rod bush.... Length cylinder head...

REMARKS.

Weight of piston. ... .
Weight of conn. rod..... .....
Weight of crosshead.....

In filling out this blank, if no deviations have been made, the word "standard" is written in. If there are variations the dimensions to thousandths of an inch are noted. Should repairs be made by the company upon any of these engines, there will be added to the record at the works all changes in dimensions that may result, such as the diameter of a re-bored cylinder, etc.

Patterns are now being made for a portable engine, 9″x12″, which is to have valve and valve gear (automatic) similar to the "straight line." The frame is of the "trough" type. The drawings show means of fastening to boiler that would seem to provide very effectually for the effects of expansion in all directions without injurious strains. For the purposes for which this engine is required it is essential to be able to vary the speed while running. This is ingeniously accomplished by the use of two friction hand wheels. Normally these wheels revolve with the engine, but a slight pressure of the hand (there are no projecting parts or arms to catch the hand) will retard them. Retarding one increases the speed; retarding the other decreases it.

We noticed the foundry at work on 10-inch pipe. This we learned was for conveying steam from the river at Binghamton to the Insane Asylum, a distance of 1,700 feet. The reason for carrying the steam this distance is to save the expense of hauling coal from the river to the ayslum, and of pumping the water required for the boilers. It looks to be of doubtful expediency. With this pipe were a number of 10-inch long radius elbows. In making these an excellent plan for getting rid of anchors and chaplets was adopted. The core arbor has a flat projection at each end which is bolted to a suitable projection in the nowel. Then at the ends of the core are flanges, which are turned to fit corresponding bearings bored in ribs in the cope and nowel. In closing down, the core is firmly held by the flanges, or their bearings, against the possibility of rising or moving in any direction. The bolting down referred to need only be sufficient to hold the weight of the core till the flask is closed.

The Berlin Metropolitan Railway.

The construction of this railway was one of the most costly undertakings of its kind. It was constructed by Government at a cost of about £3,750,000, nearly one-half of which was required for purchase of land and payment of indemnities. The length of the line, which extends from the Schlesische station to Charlottenburg, is about seven miles of double road. This brings the cost to about £300 per yard. One of the lines is used for the main line trains, and the other for local traffic. On the latter there are about 25,000 to 30,000 passengers per day, giving a total of some 10,000,000 passengers per annum. The annual working expenditure is about £180,000, and the receipts £160,000. The deficit of £20,000 is, however, only apparent, as the main lines, which are also owned by the Government, benefit from the system.—*Engineer and Iron Trades Advertiser.*

Moulding Pulleys.

BY ROBERT E. MASTERS.

In striking up pulleys of ordinary size or making them from a segment, it is handier to strike up or ram up the outside of the rim in a flask, so as to be able to cheek them off.

In the first case, when the outside of the rim is struck up it can be set aside while the inside of the pulley is being made; in the second case after the mould has been rammed up from a segment and the outside lifted off one can get at the inside of the mould to dress it up. But this method cannot always be practiced, even when a full pattern is used, as was shown in the last article on this subject. When moulding a large pulley in green sand it is the safest plan to make it all in the floor.

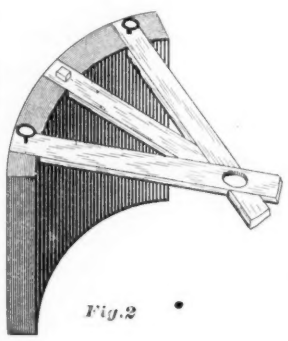


Fig.2

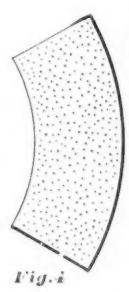


Fig.1

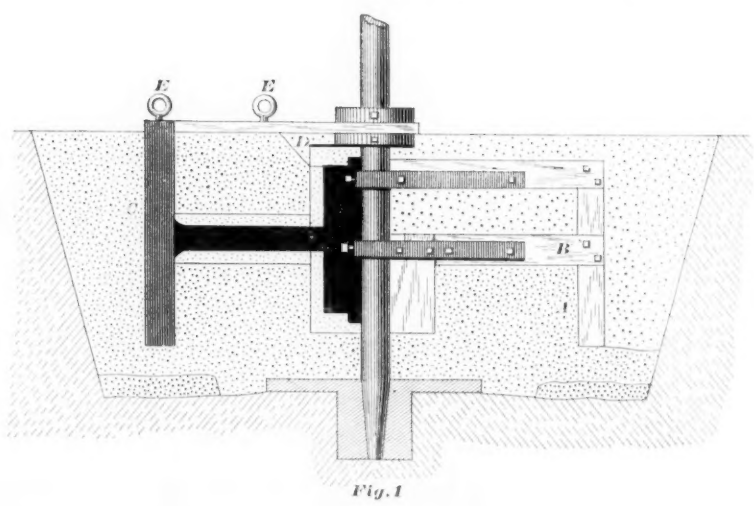


Fig.4

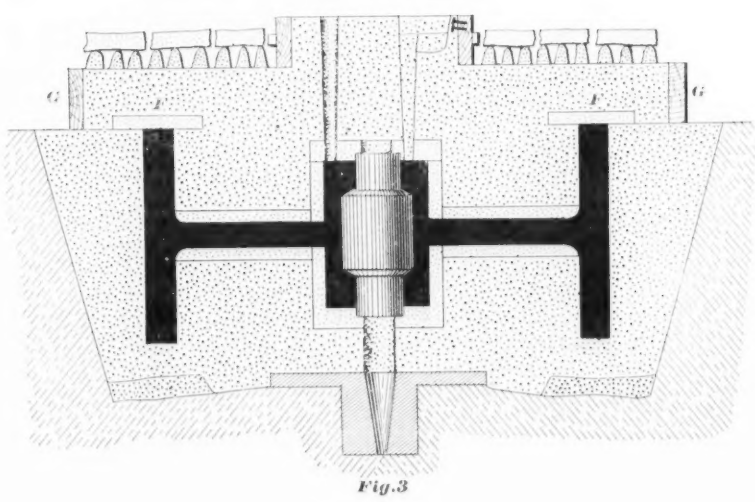


Fig.3

MOULDING PULLEYS.

In this article is shown one way of moulding a pulley 12 feet diameter, 22 inch face. A piece of boiler iron is first used to bank up the sand against at *A*, Fig. 1, then build the lower half of the core up in the rough. This is then struck off for the arms and lower half of the hub core with strike *B*. The core is dressed up and the strike and spindle taken out. The hub cores are then set in, the spindle replaced and the hub cores leveled and centered by the spindle. The arm cores which are in halves (top and bottom) are filled in and the joints filled up with stiff blacking.

We have found it the better plan to thus strike up the lower half of the core, as it gives a chance to work around it and line up the arm cores, and it also gives a backing for the segment when ramming up the outside and prevents ramming it out of true at the bottom.

The segment pattern, Fig. 2, is rammed up on the outside *C*, Fig. 1, the top set collar loosened and the segment drawn up a little and then let down again and rammed inside and outside the full depth with the exception of D, which is left so that after the circle has been completed and the spindle taken out the upper half of the hub core can be taken off and the center core set.

This starting the rim loose when rammed half way up makes it much easier to draw when rammed up its full depth. The ring bolts *E E* for drawing the segment, go all the way through it, and are fastened to a plate underneath so there is no danger of it pulling apart. Fig. 1 shows two views to the right of the spindle striking up the lower half of the core, and to the left the hub and arm cores are set and the segment rammed up.

After the circle has been completed the rim is covered with segment cores as seen in section *F F*, Fig. 3, and plan Fig. 4. Some of these cores had holes in them for risers over the rim. *G G* are pieces of plank tacked together at the ends braced outside and filled in with sand. This pulley is well weighted down over the hub (not shown in the drawing).

Speaking about the holes for risers in the segment cores, reminds me of a bright idea that a moulder who worked with me put in practice to "watch up" large or small moulds, which I believe to be original with him.

In making a casting which it was important we should pour fast and yet avoid straining, instead of putting a clay plug in his riser or covering it with a plate, he made a smooth parting on top of the flask around the riser and laid on a sheet of mica. On top of this he put a large cast iron washer. This makes an air-tight stopper, and through the hole in the washer the iron can be "watched up" from the bottom of the mould. This is too valuable an idea not to "give it away" to the readers of the AMERICAN MACHINIST, and Daniel Cunningham, the moulder spoken of, has given me permission to do so.

The *Baltimore Manufacturers' Record* publishes its usual quarterly list, giving name, location and character of business of the new enterprises started in the South for the three months ending Oct. 1, 1886, and existing establishments rebuilt. It says:

The industrial growth of the South continues to attract the attention of the business world. It is, indeed, the wonder of the age. Even the West, in the days of its greatest progress, probably never saw such tremendous strides of progress as some portions of the South are now making. New enterprises of gigantic proportions are following one upon the other so rapidly that there seems to be no limit to the possibilities of the South in the development of its enormous mineral wealth. The center of interest for some time has been in the progress of the iron and steel industries, and in these the activity during the last nine months has been simply startling. The most extensive enterprise of this kind ever organized in the South has just been formed by a consolidation of the Pratt Coal and Iron Company, including the Alice furnaces and the Linn Iron Works, of Birmingham, with the Tennessee Coal, Iron and Railroad Company, the new corporation having the enormous capital of $10,000,000. This company will build five large furnaces, on two or three of which work had been commenced prior to the consolidation, an extensive Basic steel plant and 1,400 coke ovens, besides opening several new coal mines. With the completion of these furnaces this company will have 10 furnaces of an aggregate daily capacity reported of 1,400 tons."

* * * * *

"During the last nine months this industrial growth has added to the number of manufacturing and mining enterprises in the South, 42 ice factories, ranging in cost from $15,000 up to $150,000 in one case; 56 foundries and machine shops, many of them of large size; 1 Bessemer steel rail mill; 16 miscellaneous iron works, including iron pipe works, bridge and bolt works, etc.; 5 stove foundries, 19 gas works, 23 electric light companies, 8 agricultural implement factories, 114 mining and quarrying enterprises, 12 carriage and wagon factories, 9 cotton mills, 19 furniture factories, 21 water works, 44 tobacco factories, 71 flour mills, 362 lumber mills (not counting small portable saw mills) including saw and planing mills, sash and door factories, stave, handle, shingle, hub and spoke, shuttle block factories, etc., in addition to which there was a large number of miscellaneous enterprises."

LETTERS FROM PRACTICAL MEN.

A High Speed Rotary Engine.

Editor American Machinist:

Fifty or more years ago there was built at this place (Syracuse) what was known as the Avery Rotary Engine; these engines were used at that time quite extensively in this vicinity, and though well known here many of your readers probably never heard of it. To render what follows intelligible a brief description may be necessary.

The steam entered the end of a hollow shaft, passed out through the center of two straight arms and escaped into the open air at two opposite openings in the back corners of the arms, each equal to the $\frac{1}{16}$th of a square inch. Its action was the same as what is known as the Barker wheel or mill in the books, but the Avery part of it consisted in making the arms of thin sheet steel brazed together so that, in the form of wide thin blades, they might go through the air with little resistance. I have just come into possession of Mr. Avery's note-book dated 1835 and '36, and find in it many statements of interest. In one place he says: "I ran the end of the arm in the locomotive 77,938$\frac{1}{2}$ feet, or 14$\frac{3}{4}$

miles per minute." This with a seven foot arm, which he speaks of in another place (as the two arms were made in one piece that would mean 7 feet in diameter) the engine must have run at 3,500 revolutions per minute or what seems to me something rather ahead of modern high speed practice.

The defect in this engine that led to its abandonment was that in about three months' use the front edge of the arm, which was of tempered steel, would be eaten away by coming in contact with the jet of steam issuing from the other arm. Aside from this the Avery was probably the best rotary engine ever built. It possessed the essence of simplicity, and was as economical in the use of steam as the slide valve engine of its day, particularly so when used for work requiring high velocities.

The locomotive above referred to was here, but as there was no railroad here the engine was sent to New York and tried on the road between there and Newark. I am not able to learn with what success—or rather wherein it failed. JOHN E. SWEET.

Straightening a Shaft.

Editor American Machinist:

In your paper of Oct. 23 I read an article upon Straightening a Shaft, by T. L. Johnson. I will tell you how I straightened a shaft recently. It was 16′ long, $2\frac{5}{16}$″ diameter, and had a 40″ pulley, 8″ face upon each end, one tight and one loose pulley, 8″ face upon the middle of shaft. Without taking it out of its bearings I took a piece of timber 8″x8″,10′ long and hung it to the shaft by a $\frac{5}{16}$″ chain, at each end of timber, the timber being about 24″ below the shaft, then chalked the shaft at the high point, then turned that point down, then set a jack screw upon the timber with top of jack at the chalked point, turned up the screw a little, took out jack, chalked again, and repeated the operation until I had the shaft straight. The whole operation did not take over one hour. This shaft was $\frac{1}{2}$″ crooked, and I once straightened a 3″ shaft the same way that was bent 6″.

C. W. SMART.

Drawing Room Kinks.

Editor American Machinist:

In your issue of August 28, 1886, a paper entitled "Work and System in the Drawing Room," by C. L. Redfield, attracted my attention. I would like to suggest some slight changes in his "system" which I think would be an improvement. In the first place he recommends making a pencil drawing and then tracing it on cloth. Why not make the drawing on paper that can be printed from, and not go to the trouble of tracing it off? Crane's "bond paper" will stand any amount of hard usuage in the drawing room—much more than any tracing cloth will—for generally when you give a draftsman a tracing to make a drawing from it is ruined for all future use in the blue print frame—while from the "bond paper" a print can be taken as good as from tracing cloth and will last in good condition much longer. I agree with him in saying that "no drawing should be measured but by the draftsman. For dimension lines he says use "Windsor & Newton's carmine cakes." Moist "scarlet vermilion" will look full as well on the drawing and print as good as black lines will. "Chrome yellow" will also print as good as black. I have tried both these colors and know this to be so. On the print you cannot tell which is black, yellow or vermilion. If instead of vinegar to mix the ink with you use a solution of borax and shellac boiled up in water it makes the ink so hard that the flies cannot eat it, and has the additional advantage that it will not run when wet with water, but flows freely from the pen. I always mix my ink until a dry line always follows the stick of ink, and find that it makes the best print.

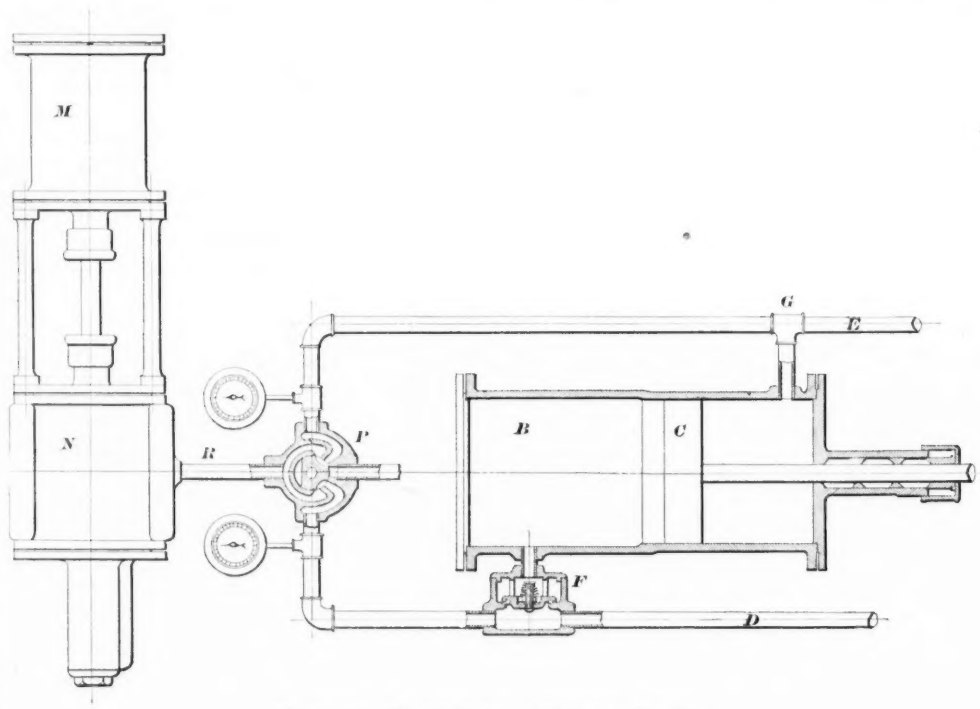
He did not say anything about the style of figures to be used. A figure made like the ordinary roman type will always print better than the common script, and is easier to read. The fractions should always be made with a horizontal line as $\frac{1}{2}$, $\frac{3}{4}$, $\frac{7}{8}$, etc., not with an oblique line, where you are liable to take the dividing line for a dimension. For making these roman figures a "Russia moheta," No. 32, is very good. A nice style of letter for a drawing, and one easily made, is the italic made with Gilllots' 303.

T. EVERETT AUSTIN,
2,144 Mervine st., Philadelphia.

Hanscom's Straight-Air Automatic Brake.

The mechanism included in Hanscom's automatic brake, illustrated herewith, consists of an air compressor for compressing the air; a brake cylinder under each car connected to the ordinary brake gear; two train pipes for conveying the air from the air compressor to the brake cylinders; an engineer's brake valve for directing the air into either end of the brake cylinder, and an automatic valve by which air is retained in one end of the brake cylinder, so that in case of the train breaking in two the brakes will be automatically set on every car on the train.

The object of this invention is to obtain a more perfect control of the train than has hitherto been attainable, and at the same time to simplify and reduce the mechanism necessary to accomplish the purpose desired, making it less subject to too rapid deterioration and less liable to interruption from slight causes. The cut shows the general arrangement and construction of the various parts, one to the other, without showing the hose and couplings which are usual to connect the train pipes on one car with another.



HANSCOM'S STRAIGHT-AIR AUTOMATIC BRAKE.

The following letters refer to the various parts:

N, air pump for compressing air.

R, pipe leading to valve *P*, which is operated by the engineer.

D and *E*, two train pipes running from the brake valve *P* to the brake cylinders under each car.

B, brake cylinder.

C, piston for brake cylinder.

F, automatic valve.

Each of the train pipes has a pressure gauge attached to it, so that the pressure in each pipe is indicated at all times, and the difference between the two shows the acting air pressure on either side of the piston.

A spring, such as is usually used, is placed around the piston rod for drawing back the piston *C* when the air pressure is released.

No reservoir other than the brake cylinder is used, the air being compressed directly in the brake cylinder where it is to be used.

The engineer's brake valve *P* is so constructed that when it is in its mid-position, which it occupies when the train is running, the air from the pump flows freely through it into both train pipes and into both ends of the brake cylinder, so that the pressure on both sides of the piston is equal.

By moving this valve either to the right or left, the air may be released from either end of the brake cylinder, while the opposite end is in direct communication with the air-pump, and the pressure on that side of the piston may be increased to the extent of the boiler pressure and proportions of the steam and air cylinders of the pump.

Any change of pressure is indicated by the gauges, so that the engineer has before his eyes just the exact force which is being applied to the brake shoes.

These gauges are placed in a convenient position in the cab. It will be seen that the engineer has positive control in directing the air into either end of the brake cylinder.

The automatic valve *F* is attached to the rear end of the brake cylinder, and is so constructed that it will allow the air to flow freely into the brake cylinder, but its outflow is retarded by the small valve which is kept to its seat by a spring. This spring is adjusted to any pressure which it is desired to retain in this end of the cylinder, so that in the event of an accident and the train breaks in two, a sufficient pressure of air will be maintained in this end of the cylinder to set the brakes and stop the train.

The train pipe *E* has no valve between it and the brake cylinder, so that the air has free ingress and egress.

In connection with this the supervising engineer, Mr. J. W. Henderson, says: "The brake has been in use on the North Pacific Coast Railroad for the past six months, on engine No. 7 and five cars, running a distance of 162 miles per day, and up to the present time a total of 24,000 miles, without a delay of any kind, with an average of 60 stops per day. There are two grades—one of five miles, between Howards and Tyrone, of 121½ feet per mile; the other, between San Anselmo and White Hill, of 121 feet per mile. This brake controls the train without shock or jar, and is under positive control of the engineer in applying and releasing. It has given universal satisfaction both to the managers and employes." It is the invention of W. W. Hanscom, of San Francisco, Cal.

Locomotive Engineers and Their Families in Holiday Attire.

The opening exercises of the Twenty-third International Convention of the Brotherhood of Locomotive Engineers was held in the Metropolitan Opera House, New York, on the 20th of this month. It was attended by locomotive engineers and their families from all parts of the country, and we believe that a more picturesque, enjoyable and profitable meeting could not be imagined. Excellent music, speeches of high order, and good will to all was the rule of the hour. We congratulate the Brotherhood on their success of the grand opening exercises, and hope that the rest of their stay in this city will be as enjoyable and profitable to them as the beginning. The addresses were delivered by the Hon. W. R. Grace, Mayor of New York; Gov. Leon Abbett, of New Jersey; Rev. T. De Witt Talmage; P. M. Arthur, Grand Chief Engineer; and Hon. Chauncey M. Depew. All speakers agreed that it was proper for laboring men to organize and protect their rights and resist all ill usage and oppression by incompetent men, and intimated that if organizations by workingmen who are governed by the motto adopted by the Brotherhood, namely, "Sobriety and Truth, Justice and Morality, Defense not Defiance, Reason not Violence," would certainly obtain all their just demands, and very quickly too, without resorting to strikes. It was further declared that organizations governed by such a wise leader as their Grand Chief Arthur would be beneficial to the employer, employe, and the country at large.

In these times of strife between capital and labor, we believe that the remarks by the Hon. Chauncey M. Depew were fitting and most happily made, and command attention not only by those who hold the same views, but should also be carefully considered by those who at present look upon labor organizations with disdain. In the course of his remarks he said: "I believe that all railroad presidents in the country, who, when the engineers have anything to say and knock at their doors, will dismiss all others and admit the engineers and give them attention."

This is a high tribute to the Brotherhood, and which they well deserve. In short, a man that can utter such remarks as were made by the Hon. Chauncey M. Depew deserves the respect and the good will of his workmen. Indeed, when the employers and employes meet on such good terms as they did at the Metropolitan Opera House, New York city, on Oct. 20th, 1886, strikes will be things of the past.

The *Star*, speaking of recent transactions by which the Standard Oil Company has bought up the most of its few rivals that remained in the field—transactions running into the millions—mainly quotes the remarks of its informant: "We think recent developments favor higher prices for oil." We should say there wasn't a doubt of the truth of this prognostication. It is "founded on fact," and probably on a good deal of knowledge of what is to come. "Gathering them in," the *Star* calls it. That's right. The opposition will soon all be gathered in, then the public will—a little more—be taken in and done for.

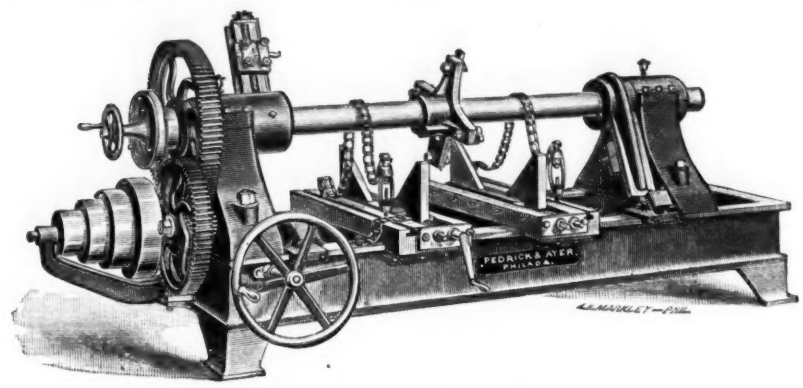
Modern Locomotive Construction.

BY J. G. A. MEYER.

TWENTY-EIGHTH PAPER.

WITH A STATIONARY LINK THE LEAD IS CONSTANT.—In our last paper we stated that when a stationary link is employed the lead remains constant at whatever point of the stroke the steam may be cut off. The truth of this will be evident by referring to Fig. 166. Here—as the position of the slide valve indicates—the piston stands at the beginning of the back stroke, and consequently the center of the crank-pin will be at *U* on the center line of motion *L M*. In order to enable us to trace the action of the mechanism of the valve gear as clearly as possible, we have represented the latter by its center lines. All lines drawn in full represent the position of the different parts of the valve gear when the piston is at the beginning of the back stroke, and consequently correspond with the position *U* of the crank as shown. All the dotted lines represent the position of the mechanism when the piston is at the beginning of the forward stroke, and consequently will cor-

respond with a position of the crank opposite to that of *U*. The line *d k* represents the center of the valve rod link, and the distance from *d* to *k* represents the length of the valve rod link from center to center of pins. The arc *d l* represents the link arc, that is, an arc drawn through the center of opening in the link. And here again, for the sake of simplicity, we have assumed that the center of eccentric rod pins are located in the same arc *d l*. In this case such an assumption will not affect the correctness of our reasoning. The distance between the points *d* and *l* on the arc *d l* represents the distance between the eccentric rod pins. The circumference of the circle *f b* represents the path of the center of eccentric. The point *f* in this circumference represents the position of the center of the forward eccentric, and the point *b* in the same circumference represents the center of the backward eccentric. Both centers *f* and *b* are shown in the correct relative positions to that of the crank, and when the piston is at the beginning of the back stroke. When in this position the points *f* and *b* will lie in a line parallel to the line *S T*, which is drawn perpendicular to *L M*. The point f_2 represents the position of the forward eccentric, and b_2 represents the position of the backward eccentric when the piston is at the beginning of the forward stroke. These points f_2 and b_2 will also lie in a straight line parallel to the line *S T*. And since the points *f* and *b* lie in the same circumference, and also in a line perpendicular to *L M*, it follows that the points *f* and *b* are equally distant from the center-line of motion *L M*. The same remarks apply to the points f_2 and b_2. The full lines *f d* and *b l* represent the center lines of the eccentric rods when the piston is at the beginning of the back stroke, and the dotted lines b_2 l_2 and f_2 d_2 represent the center lines of the eccentric rods when the piston is at the beginning of the front stroke. The link is suspended in such a manner, so that when the piston is at the beginning of the back or front stroke, the center line of motion *L M* will pass midway between the ends of the link, or in other words, the line *L M* will pass midway between the points *d* and *l*. In stationary links the radius of the link arc *d l* is equal to the length *d k* of the valve rod link. Now since the centers *f* and *b* of the eccentrics lie in a straight line perpendicular to *L M*, and since the lines *f d* and *b l* are equal in length, and also, since the lines *f d* and *b l* when produced towards *L* would form equal angles with the line *L M* it follows that the point *k* from which the arc *d l* is drawn will also lie in the line *L M*. Consequently, when the link block is lowered, or, that is to say, when the center *d* of the valve rod link is moved towards *l* the point *k* will remain stationary, and therefore the lead will not be changed, no matter what position the link block may occupy in the arc *d l*. But when the link block is at *d* the valve motion is assumed to be in full gear; on the other hand, when the link block occupies a position on the arc *d l* anywhere between the points *d* and *l*, the valve motion is not in full gear, the travel of the valve is changed, and consequently the point of cut-off is also changed without changing the lead of the valve.



CYLINDER BORING AND FACING MACHINE.

ANGULAR ADVANCE OF THE ECCENTRIC.—In our last paper we also stated, that when a stationary link is used, the angular advance of the eccentric will be less than that which is necessary when a shifting link is employed. In the first place then, let us consider why this should be so; and secondly, let us establish a method for finding this angular advance of the eccentrics.

We have already seen that when the piston stands at the beginning of back stroke, one end of the valve rod link will be at *k*; and when the piston is at the beginning of front stroke, the same end of the valve rod link will be at *n*. The distance between the points *k* and *n* on the line *L M* must be equal to twice the linear advance of the valve. Again, since the two lines *d k* and d_2 *n* are parallel, it follows that line d_2 *d*, which is drawn parallel to *L M*, must be equal to the distance between the points *n* and *k*, or in other words, the distance between the point *d* and d_2 must be equal to twice the linear advance of the valve. Also notice that when the piston stands at the beginning of back stroke the eccentric rods *f d* and *b l* do not cross each other; on the other hand, when the piston stands at the opposite end of the stroke the eccentric rods do cross each other, as shown by the dotted lines b_2 l_2 and f_2 d_2. Now, it must be easily perceived that since the angle formed by the line *f d* (when it is produced towards *L*) and the line *L M* will be less than the angle formed by the lines f_2 d_2 and *L M*, and therefore, on account of the inequality of these angles the distance between the straight line that may be drawn through the points f_2 and b_2 and the straight line drawn through the points *f* and *b* will be less than the distance between the points d_2 and *d*. But the angle formed between the lines *S T* and *f c* is equal to the angular advance of the eccentric. Or again, the angle formed between the line *f c* and the line b_2 *c* is equal to twice the angular advance of the eccentric.

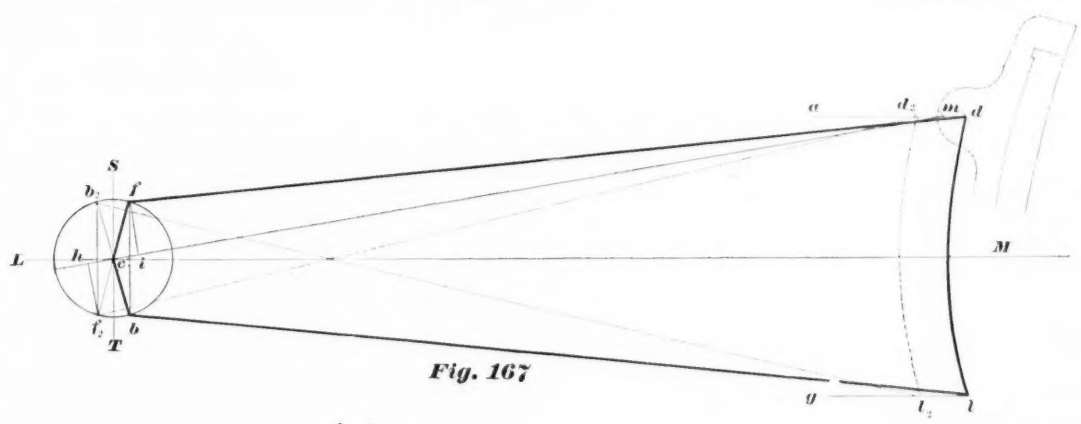


Fig. 167

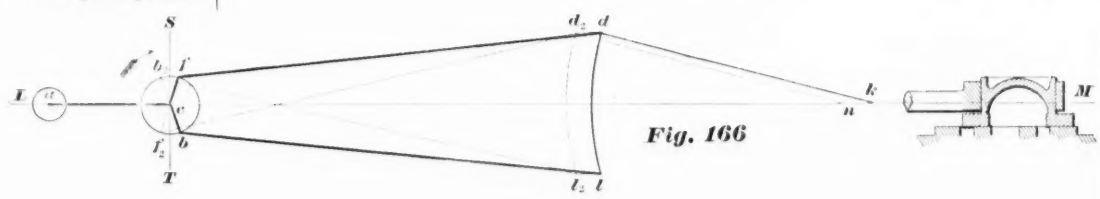


Fig. 166

But we have already shown that the distance between the points b_2 and *f* is less than that between the points d_2 and *d*, and consequently the angular advance of the eccentric will be less than the linear advance of the valve; and lastly, since in a valve gear in which the shifting link is used, as shown in Fig. 164, the angular advance of the eccentrics is equal to the linear advance of the valve, it follows that, when a stationary link is used the angular advance of the eccentrics will be less than that which is necessary when a shifting link is employed.

METHOD FOR FINDING THE ANGULAR ADVANCE.—In order to show clearly how to find the angular advance of the eccentric in a case as shown in Fig. 166, we will take the following example:

Example 34. Lap of valve is 1 inch, lead $\frac{1}{16}$ of an inch, travel of valve 5 inches, length of eccentric rods 3 feet, and the distance between the eccentric rod pins in the link is 12 inches, throw of the eccentrics to be 5 inches. Find the angular advance of the eccentrics suitable for a stationary link.

Let *c* on the line *L M*, Fig. 167, be the center of the driving axle. From *c* as a center and with a radius equal to $2\frac{1}{2}$ inches (that is, half the throw of the eccentric) describe the circle *f b*. The circumference of this circle will represent the path of the centers of the eccentrics. Draw two lines *a* and *g* parallel to the horizontal line of motion *L M* and each line equally distant from *L M*. The total distance between the lines *a* and *g* must be equal to that between the centers of the eccentric rod pins in the link, namely 12 inches. From the center *c* and with a radius of 3 feet (which is equal to the length of the eccentric rods), draw a short arc intersecting the line *a* in the point *m*. Through the point *m* and the center *c* draw a straight line *m c*; on this line, from the center *c*, and with a distance of $1\frac{1}{16}$ inch (which is equal to the linear advance of the valve), lay off the point *h*; and also with the same distance ($1\frac{1}{16}$ inch) lay off from the center *c* on the line *c m* the point *i*. Through the points *i* and *h* draw lines perpendicular to the line *c m*, intersecting the circumference of the circle in the points *f* and f_2. The point *f* will be the center of the forward eccentric when the piston is at the beginning of the back stroke, and the point f_2 will be the center of the same eccentric when the piston is at the beginning of the front stroke. From the points *f* and f_2 as centers, and with a radius equal to the length of the eccentric rod, describe small arcs intersecting the line *a* in the points *d* and d_2. Through the points *d* and *f* draw a straight line, then this line *d f* will be the center line of the forward eccentric rod when the piston is at the beginning of the back stroke. Through d_2 and f_2 draw a straight line, then this straight line $d_2 f_2$ will be the center of the same eccentric rod when the piston is at the beginning of the front stroke.

The distance between the points *d* and d_2 will be equal to twice the linear advance of the valve very nearly. We say "nearly," because this method of finding the angular advance is empirical, and can be accepted only as an approximate method. Yet in ordinary cases the difference between the line *d* d_2 and the linear advance is inappreciable, and even in extreme cases, such as represented in the figure in which the eccentric rods are comparatively very short, the result is very nearly correct. Yet in every case the distance between the points d_2 and *d* found by the foregoing method should be compared with the linear advance of the valve, and when it is found that the distance between the points *d* and d_2 is greater than twice the linear advance, the former must be corrected by changing the positions of the points *f* and f_2. The difference is generally so small that the correction necessary for the positions of the points *f* and f_2 can very readily be seen. In this example the linear advance of the valve is $1\frac{1}{16}$ inch, and according to the construction in Fig. 167 the angular advance of the eccentric is $\frac{1}{16}$ of an inch measured on a line drawn through the point *f* perpendicular to the line *S T*. The point *b* represents the center of the backward eccentric when the piston is at the beginning of the back stroke, and the point b_2 represents the center of the same eccentric when the piston stands at the beginning of the front stroke. The position of the point *b* is found by drawing through the point *f* a straight line *f b*, parallel to the line *S T*. The point *b* in which the line *f b* intersects the circumference of the circle is the center of the backward eccentric. In a similar manner we find b_2 by drawing a line through f_2 parallel to *S T*.

Cylinder Boring and Facing Machine.

The cylinder boring and facing machine shown by engraving on this page, has recently been designed by Pedrick & Ayer, of Philadelphia. This establishment (the L. B. Flanders Machine Works) has had over twenty years experience in building and operating portable cyinder boring machines and boring bars for straight, taper and lathe work. This machine is designed for new work in shops. It will bore from 8″ to 22″ cylinders, facing off the ends and boring at same time. The flanges are turned afterwards, as the saddle that the cylinder is fastened to has a movement of several inches either way (a bent tool is placed in the facing-head and the cylinder is moved). The Vs that hold the cylinder are independent of each other, each being adjusted by separate screw, allowing any shaped cylinder to be quickly brought central. Any kind or shape of saddle for different kinds of work to be done in duplicate can be bolted on to them—gaining time thereby. The saddles are held firmly to the bed of the machine by eccentrics with handles while boring and facing. They are also held in position by gibbs that allow them to slide while turning the flanges, the sliding being done by large hand wheel at front end of machine. The cross-feeding on slide rest for facing is fed with a star wheel operated by a little device that slides on the top flange of the bed and has pins, by turning which half-way round feeds either in or out—so that a roughing cut can be taken one way, and by reversing the finishing cut can be taken. By simply unscrewing one screw the bar can be pulled out of the way and supported until cylinder is placed in position. Then slip bar in the other bearing and proceed to set cylinder true with bar. The clamping device, one of the novel features, is a detachable link chain that can be lengthened or shortened, holding the cylinder and allowing very little opportunity for springing. The saddles of the machine have each a T-slot in them to slip bolt heads into for fastening the work to them. By taking out three cap screws, the Vs can be taken out and the saddles brought together so as to form a level bed 30″x24″ for any kind of boring and facing, such as pedestals, etc. By loosening one set screw, the bar can be pulled clear of the cylinder and shoved into its place after the cylinder is placed on the Vs. The feed-casing on the end of the bar contains gearing that admits of several changes of speed, and of feeding either way to suit the work. This gearing is driven by a four-step cone pulley. The head or bar support on the opposite end of the driving-gear, slides on the shears to accommodate different lengths of cylinders. A counter-shaft with cone, tight and loose pulleys go with the machine. The machine will be found especially useful and convenient in railroad shops and steam-engine works.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.
JACKSON BAILEY, Vice-Pres't.
LYCURGUS B. MOORE, Treas. and Sec'y.
96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

SUBSCRIPTION.

$2.50 a year in advance, postage prepaid in the United States and Canada.
$3.50 a year to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, NOVEMBER 6, 1886.

CONTENTS.

	PAGE
Ninety-Inch Belpaire Fire-Box Boiler	1
Practical Drawing. By J. G. A. Meyer	2
Improving the Water Supply of a City	2
Machine Tools for Pattern Makers. By F. W. Barrows	3
With Best Wishes	4
Rolling Conic Sections Applied to Circular, Elliptic, Parabolic and Hyperbolic Gears. By George B. Grant	4
At the Straight Line Engine Works	4
The Berlin Metropolitan Railway	5
Moulding Pulleys. By Robert E. Masters	5
Letters from Practical Men — A High-Speed Rotary Engine. By John E. Sweet—Straightening a Shaft. By C. W. Smart—Drawing-Room Kinks. By T. Everett Austin	5, 6
Hanscom's Straight-Air Automatic Brake	6
Locomotive Engineers and their Families in Holiday Attire	6
Modern Locomotive Construction. By J. G. A. Meyer	6
Cylinder Boring and Facing Machine	7
More Labor Troubles	8
A New York Constitutional Convention	8
Adapting Work to Suit Customers	8
Literary Notes	8
Questions and Answers	8
Business Specials	9
Manufactures	9
Machinists' Supplies and Iron	10

More Labor Troubles.

Labor troubles are much less than they were last spring, and there was reason to hope that the country would not be much disturbed by them during the fall and winter, especially since business has so much improved. On the contrary, labor troubles are increasing. Last spring the workmen were chiefly responsible for labor disputes; now the employers of workmen are starting the principal contests. It is not easy for the public to trace all the labor disputes in coal mines and determine which party is at fault, for the ruptures are too many and too prolonged for the average citizen to keep informed about details.

In Chicago the pork packers, after running their establishments eight hours a day for some few months, have decided to return to ten hours. It don't require much study to see that if the packing shops in other places run ten hours a day, those in Chicago were working at a disadvantage when they ran but eight hours. If the eight-hour rule were adopted in all cities, competition would remain equal.

The knit goods manufacturers of the Mohawk Valley some time ago formed an association, and each executed a bond of $5,000, as a guarantee that they would close their works when ordered to do so by the executive officers. A labor difficulty having arisen in one factory in Amsterdam, all the knit goods factories have closed, throwing 20,000 working people out of employment. No trades union of workmen has done anything more tyrannical. We have never heard of a trades union requiring its members to make a financial pledge that they would cease work upon the order of the executive officers. Of course such a lock-out destroys good feeling between the manufacturer and the workers employed, whatever the result may be. It is said that the knit goods manufacturers who have formed an association with such arbitrary rules, are trying to force the employes to abandon their union, which is virtually a declaration that they (the employes) shall not be allowed the same liberty of action in clubbing together as their employers. It forms no adequate excuse for these manufacturers to tell the public that some of them have been subjected to the same kind of action on the part of the workmen. If it was ever unjust and tyrannical, it is so now, and two wrongs do not make one right. The domination of might will not settle the question at issue, unless it also be the triumph of right. Conciliation, not war, is what is wanted to quiet labor troubles.

A New York Constitutional Convention.

The Constitution of the State of New York, which was adopted in 1846, is subject to revision every twentieth year if the people so decide. In 1866 a constitutional convention was ordered to do the work of revision, and this year the question whether there shall be a constitutional convention next year to make another revision is to be decided at the general election. If a majority of the people who vote for legislative candidates this fall also vote "for a convention to revise the constitution and amend the same" (as the ballot reads), the legislature at its next session will provide for the election of delegates to such convention. As a majority vote is required to order a convention, casting a vote for member of the legislature and neglecting to vote on the convention question counts one vote against the convention just the same as if a ballot was cast with the word "against" instead of "for."

A convention ought to be held to make some needed changes in the fundamental law of the State. For instance, the people of the State decided at the general election three years ago, by a large majority, that the contract system of employing labor in prisons should be abolished. The way to abolish the system so the legislature cannot tamper with the decision is to put it in the constitution. Of course the prison contract ring oppose the holding of a convention, but the people are in its favor. Direct ballots and nothing else will bring it about. It not being a political or party question, none of the partisan organizations have provided for printing ballots. The convention was in danger of being defeated by default, but the New York *World*, with commendable enterprise and patriotism, decided to print five million ballots at its own expense and supply the committees for distribution. If they are well spread over the State the convention will doubtless be held.

Adapting Work to Suit Customers.

The old question whether it is best to alter patterns of machines to suit customers is still a live one. Some establishments persistently refuse to change any feature of a machine even to secure a good customer; others will make such changes as purchasers want and will pay for, provided they do not impair the efficiency of the machine. The question probably never will be settled universally, but the advocates of special changes, to order, are apparently making progress in this country. There is no room to dispute the fact that many valuable permanent improvements have been made in machines by changing patterns to suit certain customers and watching the results after the machines went into use. While no establishment can be expected to make every change asked for, purchasers who want slight alterations could usually be accommodated without inconvenience. Those who refuse to change any feature of a machine, to order, contend that the reputation of their product is at stake, and if the practice of changing patterns to please individual customers is once begun, it will lead to questionable styles of construction and the condemnation of some machines and the builder of them, because of the failure of supposed improvements.

In England it is the regular practice to build iron working machinery after the designs of purchasers. New patterns or changes in patterns must be paid for, and it is universally understood that purchasers assume the weight of responsibility if such machines do not work successfully, except in cases where the fault can be traced to bad material or bad workmanship.

While free scope is given in England to originality of design in machinery and iron work, there seems to be more conservatism in adhering to established plans than in the United States. The English manufacturer is not quick to meet the peculiar requirements of customers thousands of miles away when to do so would require radical innovations. The London *Engineer* mentions one case in a recent editorial, which we quote:

We have on previous occasions spoken of the loss to Britain which results from inertia amongst our bridge builders. Some of this is due to the out-of-date regulations of our Board of Trade; but so far has the British bridge-building trade become wedded to old methods of manufacture and terms of business, that American and Canadian bridges are now being bought by English civil engineers for railways in course of construction, though not in either of those countries; but we need not say in which. The orders are going to those countries because really satisfactory bridges can be obtained to carry a given load, and with a guarantee for ten years, for a sum which is not more than 60 per cent. of the price demanded by English builders. The American and Canadian bridges are well-designed, pin structures, in every way satisfying the engineers of the railway; and the builders' price is for the bridges placed upon the piers and finished, the engineers having very little more trouble in the matter than to order them and test them; while for bridges for the same places, if ordered in England, the engineers would have to provide designs and specifications, follow the structures throughout their whole history to completion, and then pay about 40 per cent. more for them. In railway matters, again, the transatlantic constructors will provide rolling stock for prices and terms which afford facilities that probably not more than one English firm give.

The above illustrates the advantage of carefully studying the wants of purchasers and in providing special facilities to supply exactly what is wanted. Inertia, however, is not confined to English manufacturers. There is a large supply of it here, and a further quotation, which we make from the same editorial in the *Engineer*, is just as applicable on this side of the Atlantic as on the other:

In these days it does not pay for any length of time to try to make purchasers suit their requirements or wishes to the manufacturers'; the latter must make what the purchaser prefers. No manufacturer can afford to continue to make a given machine of the same pattern as that he made ten years ago. He must improve it wherever possible, or another manufacturer at home or abroad will do it for him, and save him the trouble after awhile of making any.

The naughty trade unionists are making trouble in New Jersey this fall. They have a legislative committee which is instructed to prepare pledges to be submitted to candidates for offices at the election next month. They want to know how these candidates stand upon questions of paramount interest to labor. Now this kind of action is decidedly annoying to candidates. Of course they are nominally representatives of the people who elect them, and are presumed to act as such; but it is going to be fearfully embarrassing for a member next winter, when the lobbyists for the big wealthy syndicates and corporations make their annual appearance at Trenton, to think of the pledges he has made. How can he serve the people and cormorant monopolies at the same time? We have read somewhere in true blue political "reform" papers that a candidate ought to be left free to act without making pledges before election. If we may judge from the wretched legislation in some States during the last few years, candidates have usually been left free to represent anything they pleased, and we don't expect much, if any, change this year.

We recently saw an example of the re-adaptation of a machine tool in which the success was quite the reverse of that of the proverbial blacksmith who worked his material all through the list of cutting tools from a broadaxe to a hatchet, and eventually wound up with a sizzle. The tool was originally a shaper of somewhat novel construction, which as a shaper did not prove exactly a success. Setting the machine on a heavy protruding base, so that a machine three or four feet in height could be operated on, and a little change in the upper work, converted it into a first-class milling machine for certain purposes.

Literary Notes.

Mr. M. N. Forney, one of the best known men in railroad mechanical circles, formerly editor of the *Railroad Gazette*, has purchased the *American Railroad Journal*, established in 1832, and *Van Nostrand's Engineering Magazine*, and will consolidate the two with the title *American Engineering Magazine and Railroad Journal*. More space will be devoted to railroad matter than any other one department of engineering. The new publication will be an illustrated monthly "having more the character of a magazine than a trade journal." Those subscribing now to the new publication ($3.00 a year) will receive the *American Railroad Journal* free for the remainder of the year. Mr. Forney is an editor of ability, has a large circle of friends, and is likely to make the new magazine successful. His office is at 23 Murray street, New York.

The Way Bill, "a journal of transportation" is a bright, lively monthly paper published at 102 Nassau street, New York, at $1.00 a year. It is not quite a year old, but shows elements of stability and permanency.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(386) J. C. C. asks: Is it dangerous or unhealthy to use water from galvanized iron pipes for drinking or cooking purposes? If so, what effect would it have? *A.* We believe it will cause no evil effects in general health, and can be used without any fear of danger.

(387) W. A. G. asks: How can taps be backed off in a lathe? Or is there a machine for doing such work? *A.*—We have always used a file for backing off taps, and cannot see how a lathe could be used for this purpose. We have not met with a machine for doing such work.

(388) J. R. asks: 1. How can I learn drafting? *A.*—Procure a good teacher if you possibly can; if not, read good books relating to this subject. In our issue of October 23 we commenced a series of articles on Practical Drawing, which we believe will greatly aid you in obtaining the knowledge you seek for. 2. Will you give me an idea how long it would take to master the science by one of common intelligence? *A.*—Some persons will learn it quicker than others; but if you wish to become competent to make ordinary drawings in a machine shop, probably one or two years of practice will suffice. If you wish to become a thorough, reliable draftsman, probably four or five years, or more, of practice will be needed. If you wish to become competent to make any kind of drawing—in fact, to be a professor of this science—it may take you a lifetime. 3. What pay do draftsmen receive? *A.*—Draftsmen are paid according to their ability; those that can only make tracings or simple drawings receive less pay than ordinary mechanics. Good assistant draftsmen receive the same pay as first-class mechanics, and experienced, thorough, reliable draftsmen receive high salaries; indeed, the latter are very scarce.

(389) G. D. D., Hamilton, Ont., writes: Please inform me through your columns how to make, harden and temper spring calipers? *A.*—If you are a mechanic, the method of making calipers will suggest itself to you. But to harden and temper them more than one method can be adopted. Some blacksmiths give the spring a hammered temper; that is, they temper the spring by hammering, and the points are hardened in a manner similar to that adopted for hardening any other tool. Others, again, will heat the calipers to a cherry red, then plunge it into linseed oil, and when cold the points will have the right temper. But the temper in the spring is drawn by holding the spring part of the calipers over a flame until the oil begins to burn or flash, when the spring is again plunged into oil. This process of tempering the spring is called by some blacksmiths "flashing," and, in order to obtain the right temper in the spring, the process of "flashing" may have to be repeated. If it is your intention to manufacture these, we would advise you to gain admittance in a factory in which these are made, and study the whole process of making them.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Patent Att'y, H. W. T. Jenner, Washington, D. C.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Gear Chart, $1. Mechanics' Pub. Co., 5 Dey, N.Y.

Metallic Pattern Letters and Figures to put on patterns for castings. Knight & Son, Seneca Falls, N.Y.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

20", 25," 28" B.G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

The best wire nail and tack and nail machinery. Wm. A. Sweetser, Brockton, Mass.

Ice and Refrigerating Machines. 120 built, and all successful, by David Boyle, 521 Monroe, Chicago, Ill.

20,000 addresses of steam users and users of mach. in 10 States, $10. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 93 John st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co. 111 Liberty st., N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Rubber Belting, all sizes, 77½ per cent. regular list. All kinds of Rubber Goods at low prices. Jno. W. Buckly, 156 South street, New York.

Complete sets of Castings for making small and medium-sized Vertical Engines; send for prices. Humphrey's Foundry, Bellefontaine, O.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Curtis Pressure Regulators, Curtis Return Trap. Curtis Damper Regulator. See Oct. 2, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

Machinists' supplies, brass goods m'f'rs supplies, polishing materials, all kinds wire, metals, etc; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

Wanted—Good man in every shop in the South and West to sell Tools. Samples free, C. H. Besly & Co., 175 and 177 Lake st., Chicago, Ill.

"Hints to Steam Users, Engineers and Firemen." A 100-page book on care of steam boilers; just issued; containing useful rules, tables, etc; a valuable book for engineers; sent on receipt of 25 cts. in stamps. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

The Gravesend Water-Tower explosion is illustrated and described in the Oct. 23d issue of the *Sanitary Engineer*, the *Engineering and Architectural Weekly*; also, the Engineering Details of the Construction of the Bartholdi Statue. Published at 140 William st., N. Y. $4 per year. 10 cents a copy, of newsdealers.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

MANUFACTURES

Doyle & Co., Huntington, W. Va., will build a new machine shop.

A company is being organized at Knoxville, Tenn., to start an iron foundry.

Wm. Peel, Staffordsville, Conn., is rebuilding his woolen mill, recently destroyed by fire.

The Chateugay Ore and Iron Company will erect a second blast furnace at Plattsburgh, N. Y.

The American Road Machine Company is moving its works from Abington, Conn., to West Grove, Pa.

A new woolen mill, to cost $125,000, will be built in Hartford, Vt. H. N. Nanchett, superintendent.

It is rumored that the Sloss Furnace Company, Birmingham, Ala., contemplate establishing steel works.

A new shoe factory is to be erected at Nottingham Centre, N. H. E. Wilder, of Haverhill, Mass., will occupy it.

The capacity of the cotton mills of the Clegg Manufacturing Company, Columbus, Ga., will probably be doubled.

W. R. Tuttle, president of the Knoxville (Ala.) Iron Company, purchased, some months ago, the car works at Anniston, and will soon restart them.

Fred. Hosch, 782 Flushing avenue, Brooklyn, N. Y., will build a four-story fur-dressing factory, 75x70 feet, to cost $12,000.

Chas. M. White, 18 First street, Brooklyn, N. Y., will erect a factory on Third street, 60x90 feet, three stories high, which will cost $9,000.

The Birmingham Chain Works, Birmingham, Ala—B. F. Roden, president—have increased their capital stock to $30,000, and will enlarge their works.

The Holly Manufacturing Company, Lockport, N. Y., have purchased a lot on Caledonia street, and propose to build a large erecting shop, 100x165 feet.

Bement, Miles & Co., Philadelphia, inform us that orders for machine tools are coming in very comfortably with them, with future prospects good.

On the 1st of September there were 1,173 State convicts in Texas working on farms, 235 on railroads, and 1,060 confined in the penitentiaries. So says the Brenham *Banner*.

The American Tube and Iron Works at Youngstown, O., is in operation, employing 350 men. Seven hundred will be employed when the works are completed.

Keuffel & Esser, New York, send out specimens of their "helios" blue-print paper, with some excellent prints thereon. They furnish blue-print apparatus complete.

The Hudson River Ore and Iron Company has purchased the Cold Spring (N. Y.) furnace, which will now be started up again, after being idle several years.

Henry Warden, Germantown Junction, Philadelphia, has a new feed-water heater now in the Patent Office, and expects to put it on the market during the next few months.

The Ketchum Iron Company—capital stock, $15,000—has been chartered at Fort Smith, to establish a foundry and machine shop, with Thos. Ketchum as president, and J. S. Park, treasurer.

The Edison Machine Company have started up their new shops in Schenectady, N. Y. As soon as the necessary machinery can be placed, they expect to employ a thousand men.

The Humphreys Manufacturing Company, of Mansfield, O., are erecting a two-story brick machine shop, 38x240 feet, and a one-story brass foundry and blacksmith's shop, 30x140 feet.

The Baltimore Short Line Railroad Company will build a depot and engine-house and machine shop at Annapolis, Md. H. P. Underhill, 6 South street, Baltimore, is president.—*Baltimore Manufacturers Record.*

The company which supplies Washington, Pa., with natural gas charges at the rate of $12 a year for each cook-stove, $8 for the second stove in the same residence, and $6 for each additional stove or fireplace.

The St. Louis *Age of Steel* says: "A factory for the production of machinery and edge tools, principally the latter, will be opened in this city in the course of a few weeks. A new process of manufacture will be employed."

The Linn Iron Works, Birmingham, Ala., are now working on the heavy castings and furnace supplies for the Pratt Coal and Iron Company's furnaces. One of these castings requires 80 tons of molten iron.

T. R. Almond, Brooklyn, N. Y., manufacturer of the Almond drill chuck, has issued a new price-list of his chucks and turret tool. A discount is made to those buying a dozen, and an extra discount to jobbers who order fifty chucks, assorted.

The *Northwestern Miller*, of Minneapolis, says: "The matter of a sufficient water-power is becoming a subject of deep concern to mill-owners, as those well advised claim that the mills will be troubled more than ever in this respect on the advent of cold weather."

Warner & Swasey, Cleveland, Ohio, have let contracts for a new brick addition, 70x45, three stories, with tower, on account of increasing business. They are very busy on Standard brass-working lathes, Monitor lathes, screw machines and other tools.

Southington (Conn.) Knights of Labor have decided to form a corporation with a capital of $25,000 to manufacture cutlery. They will put the Knights of Labor stamp upon their goods. A large amount of stock has been taken, and work will be begun as soon as possible.

The United States Pump and Valve Company, who are manufacturers of straightaway valves and gates, and also the Pearson noiseless steam motors for street railroads, have secured headquarters at 28 Oliver street, Boston. This company is building a large factory at Saugus, which will be completed about November 1st.

The Hartford Woolen Company has been organized at White River Junction, Mass., with a capital of $100,000, for the purpose of manufacturing various kinds of woolen goods. A new factory will be erected employing 125 operatives. Ephriam Morris is president of the company; Edward W. Morris, secretary; Charles M. Cone, treasurer; and V. Y. Brennan, superintendent.

The Shellenberger Nut Lock Company, with a capital stock of $100,000, was incorporated October 4th, with George Noble as president; S. L. Shellenberger, vice-president; and Benton Quick, secretary and treasurer. The object of the company is to manufacture and sell the Shellenberger nut lock. The factory of the company will be located in St. Louis, and the general offices in Dallas, Tex.

The Stillwell & Bierce Manufacturing Company of Dayton, O., write us that business is good with them. They have just completed a large addition to their machine shop, and put in many new tools, and are now building a new foundry, 96x165 feet, with power cranes and "all modern improvements." Among recent sales of their horizontal Victor turbine wheel is one to the Hockanum Company, of Rockville, Conn.

The Lewis Foundry and Machine Company, of Pittsburgh, issue an illustrated catalogue of the machinery built by them, which includes chilled and sand rolls, roll trains squeezers, punches, shears, roll lathes, presses, and general rolling mill machinery. The catalogue is entitled "Industrial Magazine." It contains various interesting paragraphs relating to the making of iron and steel.

The Morris County Machine and Iron Company, Dover, N. J., have issued a new illustrated catalogue of mining machinery built by them. Engines, boilers, steam pumps, air compressors, and all articles for machine mining are built at their own works. They do not contract work to be done at any other shop. The catalogue is well printed, and sufficiently describes the machinery represented.

The Sheffield Velocipede Car Company, Three Rivers, Mich., have just issued their first trade catalogue, in which they represent some of their railway specialties, such as three-wheeled velocipede cars, hand car wheels, Standard section hand cars, pushing cars, the Dodge rotating stand pipe, and the Security grain door. The catalogue contains 36 pages, the engravings in it are fine, and throughout the catalogue has a fine appearance.

Paine, Diehl & Co., 12 Bank street, Philadelphia, are importing and propose putting on the market what they call "Unbreakable" file handles, made in England of "Wallwork" metal, which is said to be a kind of hardened iron harder than steel. They import the handles in the rough as castings, and finish them here. In this way the Custom House duty of ¼c. per lb. amounts to only about 10 per cent., while the duty on regular machinery is 45 per cent.

Business at the works of the Southwark Foundry and Machine Company, Philadelphia, is very active in all departments, about 650 men being now employed in building engines, hydraulic machinery, blast furnace and other work. Their new boiler shop is contributing its full share, one job being the construction of pipes for distributing natural gas through the works of the Cambria Iron Company at Johnstown, Pa. The gas is brought from about 40 miles away.

Harry Comstock, of Fulton, N. Y., writes us: "I have taken the AMERICAN MACHINIST many years, or from its infancy, and notice you like to publish new enterprises. I have been a traveling agent for E. Remington & Sons in Asia for many years, yet your papers always reached me when in the most remote part of China. I returned last December, and am now starting the manufacture of my patent lightning horse clippers, and will employ about twenty hands within a month, manufacturing them."

The Colwell Iron Works, New York, have issued a large, elaborate catalogue of their sugar machinery. It contains a number of fine lithographed plates, illustrating their different engines, evaporating apparatus, and machines for sugar-making. Many of the plates are colored so as to show at a glance the different materials—iron, copper, wood, etc. These works also manufacture cast-iron flange pipe having a standard set of patterns, from 4" diameter and 6 feet long up to 36" diameter and 15 feet long; with elbows and other special castings to match.

One million dollars of the stock of the Pratt Coal and Iron Company, of Birmingham, Ala., has been sold to John H. Inman and others, of New York, and Nathaniel Baxter and A. M. Shook. The company has the largest bituminous coal mines in the world. Nineteen-twentieths of the stock is owned by, besides the persons named, Enoch Ensley, T. T. Hillman, John H. Inman, Nathaniel Baxter and A. M. Shook, of Tennessee. The company has just determined to expend $1,000,000 in building four furnaces and basic Bessemer steel works at New Pittsburgh, six miles from Birmingham. Three more coal mines are also to be opened.

Gerard C. & Horace P. Tobey, of Wareham, Mass., contemplate erecting a large mill at Tremont for a $300,000 Bessemer steel plant for the manufacture of steel nails by the Bessemer process exclusively. This will make Tremont the center of steel nail making in the East, and the enterprise will be entered into for the reasons advanced by those versed in iron and steel, that the latter is fast superseding the former, and that it is only a question of a short time when iron nails and iron manufacture of nearly all kinds, except possibly in merchants' iron, will become an unprofitable business in New England, as a better product of steel can now be made by the Bessemer process for less money than of iron.—*Boston Commercial Bulletin.*

The Keystone Light and Power Company, of Philadelphia, are just beginning to lay their underground cable, having hitherto used only overhead wires for temporary purposes, working only up to about one quarter of the ultimate capacity of their plant. They have introduced a handy arrangement for lubricating their three Westinghouse engines and the bearings of the dynamos, which has since been adopted by others. A supply of oil is carried in an iron tank in the boiler room, elevated upon a shelf or platform near the ceiling. To this a pipe, suitably provided with cocks, is attached, connecting with the bearings which it is intended to lubricate, and insuring a constant and economical supply. Not a single squirt-can is used about the place.

The accuracy of master screws is a subject not much discussed, because it is so rare to find one that is virtually free from error. The Pratt & Whitney Company have recently made a master screw for the Niles Tool Works of quite hard steel, but with a good smooth surface. In sending the screw, they write: "We think you can say that you have the best screw in the world." The Pratt & Whitney Company have also made a special worm-wheel index for the Niles Tool Works, a test of which shows the mean error for each single foot to be less than .001 of an inch, while the greatest accumulative error for any series of five consecutive teeth is .0025" and .0015" respectively. In sending the plate, the Pratt & Whitney Company write: "In our opinion, you have the most accurate index plate and worm in this country, excepting, perhaps, that in the Coast Survey, and one or two small ones used for scientific work."

The Troy *Standard*, in noticing the new plant of the Troy Steel and Iron Company being built by J. P. Witherow, of Pittsburgh, says: The plant consists of three blast furnaces, twelve Whitwell stoves, seven blowing engines, six steam pumps, three hoist towers, with smoke-stack, boiler-houses, engine-house and water tank complete. The three hoist towers, which are seen so plainly from the river or cars, are each 108 feet high, and are really marvels of strength and beauty. The stack, which is visible for miles around, stands out in bold relief 216 feet high from the level of the island, with a diameter at base of 22 feet, tapering to 14 feet at top, and, with the American flag floating at the top, every day attracts marked attention. The three furnaces in the rear of the stoves are each 80 feet high, with diameter of 18 feet. The 12 stoves are each 60 feet high by 20 in diameter. There are three cast-houses, each 150 by 50; one engine-house 150 by 38, with seven blowing engines and six steam pumps. The water tank is intended to hold 162,000 gallons of water, being 60 feet high and 30 feet in diameter, and one boiler-house with complete sets of boilers. This plant, when complete, will be the largest in the United States, and will have all the improvements in machinery for speed and output of the nineteenth century. Mr. Witherow is now in Europe with a party of scientific gentlemen visiting Wales, France and Germany in the interest of the work, and intends to make it a credit to the city of Troy and second to none in the United States.

Machinists' Supplies and Iron.

NEW YORK, Oct. 22, 1886.

Iron—Market for pig is strong, but not very active. We quote No. 1 X Foundry, $18.50 to $19.50; No.2 X,$17 $17.to 50; Grey Forge,$16 to $16.50. Scotch pig is a shade higher. We quote Coltness, $21.50 to $22; Glengarnock,$19.50 to $20; Eglinton, $19 to $19.50; and Somerville, $20.50.

Lead—Dull and weak. Western sells at 4.20c., and foreign at 4.40c.

Tin—Market lower. We quote Banca, 22¾c.; Straits and Malacca, 22.25c. to 22.35c.; Australian, 22.⅜c.; and L. & F., 22⅛c.

Spelter—Demand light. Western sells at 4.30c. to 4.60c.for common, and 6c. for refined; Silesian, 4.70c. to 4.75c.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Brass Founder—A first-class brass moulder and founder wants situation. B. M., AM. MACHINIST.

Machinist foreman wanted, who can handle fifty men to advantage, and increase their production by latest improved ways of doing work. Address P., care Wilkinson & Co., 352 Atlantic av., Boston, Mass.

A first-class mechanic desires position as foreman; had 7 years' experience in charge of the manufacture of wood-working machinery, engines and mill machinery; good references. Address Mechanic, AM. MACHINIST.

Wanted—Experienced foreman for small machine shop working 15 to 20 hands on new stationary engines, mill work, general jobbing and machinery repairs; also want a few more first-class machinists. Beall Engine and Machine Works, Cumberland, Md.

Wanted—Foreman for machine tool department of a large stationary and portable engine works; must be a draftsman and familiar with valve movements and high-speed automatic engine work; must understand handling men; to the right person there is an opportunity to secure the position of superintendent of the establishment. Address, stating age, T. E. J., AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland,O.

Light mach'y of all kinds built at short notice. Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

"Steel Stamps, &c." Agents wanted in every shop; send for terms. J. E. Mathewson, Springfield, Mass.

Draftsman's Adjustable Curve Ruler; makes any curve; sold everywhere F. W. Davenport, Mfr, Providence, R. I. Circulars gratis.

For Sale Reasonably—One 12″×12″ Vertical Steam Engine, with all attachments, in good order. Address L. F. L., 218 Bay street, Jersey City.

Tabor indicators; one pair in box, with full set of springs; all in good order; $100 cash, or separate at $50. Address B., Box 99, AM. MACHINIST.

The best engines and boilers, ⅛ to 4 H.P.; economical in price, steam, etc. Washburn Engine Co., Medina, Ohio.

John Lamberty, mfr. telegraph and electrical instruments, experimental machs, models; fine gear cutting a specialty. 35 S. 5th st., Br'kl'n, E. D., N.Y.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

For Sale—Screw Plates for Bolts and Pipes, new and complete at less than manufacturer's cost, being last of an estate to be closed out. S. M. York, Cleveland, O.

Wanted—First-class Engine and Boiler, of about 20 and 30 horse-power respectively; give full description and lowest price. F. O. B., Rochester, N. Y., Rochester Plow Co., Rochester, N. Y.

Wanted—A first-class cotton and woolen shuttle maker as partner; a good opportunity for a man (who understands the business) with a small capital. Address Box 4, AM. MACHINIST.

Experimental and new machinery for special purposes built by contract from specifications and inventors' designs; ample facilities. Cohoes Iron Foundry and Machine Co., Cohoes, N. Y.

For Sale—One 30 H. P. Fire-Box Boiler, good as new, $375; one Strange Automatic Barrel Stave Saw Mill, used but a short time; also a number of Portable and other Engines and Boilers. Address Ezra F. Landis, Lancaster, Pa.

Important sale of valuable machinery at the Howe Machine Co.'s Factory, Bridgeport, Conn., consisting of milling machines, automatic screw machines, hand screw machines, drill presses, tapping machines, cam machines, lathes, planers, etc. Send for catalogues to E. Parmly, Agent, Bridgeport, Conn.

For Sale—Opportune, for engineer or draftsman, office outfit and patronage in large and thriving city in Mass.; would prefer party capable of reflecting credit on a business now well established; the proprietor is about to take charge of machine works; Boston references. Address Box No. 7, AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

For Sale—The machinery, tools, plating apparatus and raw material of manufacturing establishment; now working on orders in brass and other metals; very low rent, including steam power. Address Manfr., P.O. Box, 285, New Brunswick, N.J.

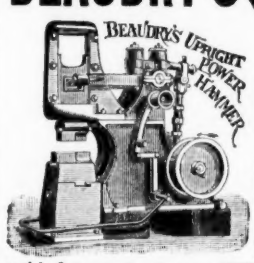
For Sale—A first-class foundry and machine shop; large connection in saw-mill county in the South, including buildings, lots, machinery, and mills' supply stock on hand; business will be carried on until sold; reason for selling, retiring from business; apply at or address Southern Foundry, AM. MACHINIST.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY & CO. Syracuse, N.Y.

BEAUDRY'S ✢ UPRIGHT CUSHIONED POWER HAMMER



The success of our machine is the best proof of its value. Is more like a steam-hammer than any other, yet has all the economic advantages of a power hammer, and is far superior to any. Will work a larger bar of steel or iron and turn out more difficult forgings than any other hammer made. **Guaranteed as represented, or no sale.**

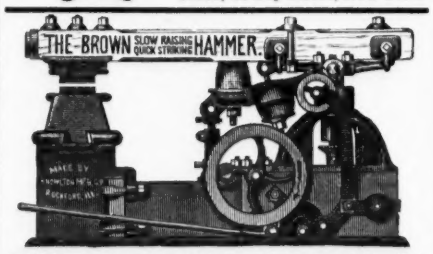
BEAUDRY & CUNNINGHAM, Boston, Mass.

STEPHENS PATENT VISES.

50 PER CENT. OF time and labor saved by using this solid, strong, durable, quick-working Vise. Has the Improved Taper, Pipe and other attachments. Sold by the trade. Send for circular

MELVIN STEPHENS, Prop'r.
Office, 41 Dey Street, New York.

THE BROWN HAMMER



STRIKES A BLOW WITH
Double the Velocity That It Raises the Hammer.
A NEW MOVEMENT! SEND FOR DESCRIPTION.
Knowlton Mfg. Co., King St., Rockford, Ill.

JUST ISSUED. NEW EDITION.

Roper's Hand-book of Land and Marine Engines. Containing a description and illustrations of every description of land and marine engines. $3.50 post paid. Roper's Practical Hand Books for Engineers and Firemen. Catalogues free.

EDWARD MEEKS, Publisher.
S. E. Cor. Walnut and 10th Sts. - - Philadelphia, Pa.

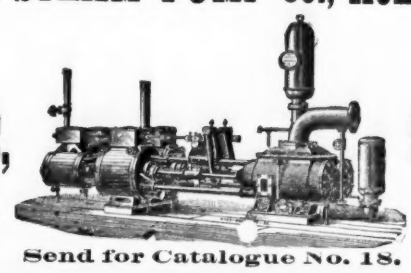
GEO. F. BLAKE MANF'G CO.
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 44 WASHINGTON ST., BOSTON.

WATER WORKS PUMPING **ENGINES A SPECIALTY**

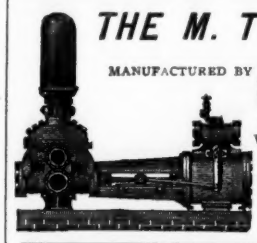
THE DEANE STEAM PUMP CO., HOLYOKE, MASS.

BUILD WATER WORKS, ENGINES AND STEAM PUMPING MACHINERY.



Send for Catalogue No. 18.

THE M. T. DAVIDSON IMPROVED STEAM PUMP,



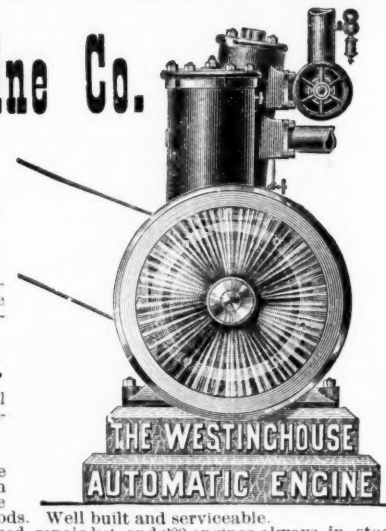
MANUFACTURED BY **DAVIDSON STEAM PUMP COMPANY.**

WARRANTED THE **BEST PUMP** MADE FOR ALL SITUATIONS.

PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

THE **HENDEY MACHINE COMPANY.**
MANUFACTURERS OF
TORRINGTON, CT.
SEND FOR CATALOGUE
Machinists' Tools, LATHES, PLANERS, SHAPERS, DRILLS, ETC., ETC.

THE
Westinghouse Machine Co.
OF PITTSBURGH.
MFRS. OF THE
WESTINGHOUSE AUTOMATIC ENGINE
—AND THE—
"JUNIOR" AUTOMATIC ENGINE.



ENJOYING the largest market of any engine manufactured in the U. S., we shall further enlarge it by a rebate to the purchaser of a share of our earnings in the shape of a

General Reduction of Price.

THE first reduction is now in effect, and others will follow as results warrant. All our latest improvements are in force.

THE "JUNIOR" AUTOMATIC ENGINE

is a special design for the Legitimate Low Price Trade. Sizes, 15, 25 and 35 H. P. only, which we **SELL AT A PRICE THAT CANNOT BE MET** by the cheapest throttling engines. Forged steel shafts and rods. Well built and serviceable.

Add to the above, absolute uniformity of parts, a priced repair list, and 200 engines always in stock, and our position in the trade is invincible. Address all correspondence to

WESTINGHOUSE, CHURCH, KERR & CO.
17 CORTLANDT ST., NEW YORK. | 98 FOURTH AVE., PITTSBURGH.

FAIRBANKS, MORSE & CO., Chicago, Ill.
FAIRBANKS & CO., St. Louis, Mo.
D. A TOMKINS, & CO., Charlotte N. C
PARKE & LACY, San Francisco, Cal.
PARKE, LACY & CO., Salt Lake, Utah.
ROBERT MIDDLETON, Mobile, Ala.
H. DUDLEY COLEMAN, New Orleans.
KEATING IMPLEMENT & MACH. CO., Dallas, Texas.

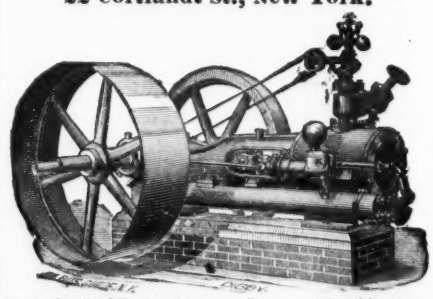
GUILD & GARRISON,
BROOKLYN, N. Y.
STEAM PUMPS,
VACUUM PUMPS,
AIR COMPRESSORS.
SEND FOR CATALOGUE.

Business Opportunity.

TO LEASE or FOR SALE. Machine shop and foundry paying large profits. Shops Leadville, Colo. Address,

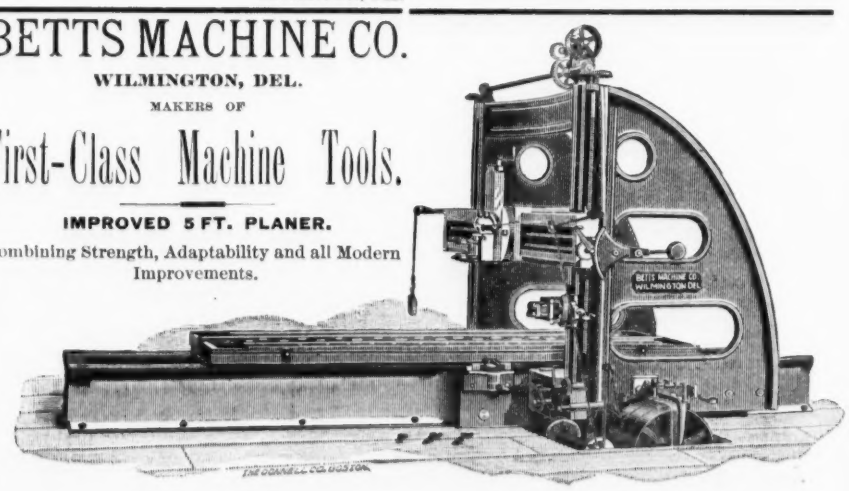
A. FALKENAU,
Care of DICKSON MFG. CO.
SCRANTON, PA.

IF YOU WANT A STRONG, ECONOMICAL
ENGINE,
Either *Horizontal* or *Vertical,*
For steady every-day and all-night service, and at a *Low Price,* write to
COOKE & CO.,
22 Cortlandt St., New York.



Twelve hundred Engines in use Please mention this paper.

BETTS MACHINE CO.
WILMINGTON, DEL.
MAKERS OF
First-Class Machine Tools.
IMPROVED 5 FT. PLANER.
Combining Strength, Adaptability and all Modern Improvements.



NICHOLSON FILE COMPANY, *Sole Mfrs. of*

FILES and RASPS Having the Increment Cut, also, FILERS' TOOLS and SPECIALTIES.

The above illustration represents a device in which files may be held for service in surface filing, and while in this condition READILY SPRUNG, in order to give at the will of the operator, more or less convexity to the working face of the file. It does away with unusual care to obtain a true convexity or "belly" to file sides, and in fact renders great service by enabling the operator to utilize the file to its full capacity.

SURFACE FILE HOLDER No. 4, Adapted to Hold Files 12, 13 14 in. Long.
" " " " 5, " " " 14, 15, 16 "

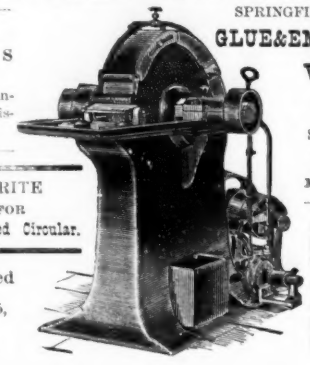
MANUFACTORY AND OFFICE - - PROVIDENCE, R. I., U. S. A.

EMERY WHEEL TOOL GRINDER.

TEN SIZES — Guaranteed Satisfactory.

WRITE FOR Illustrated Circular.

Patented Sept. 25, 1883.



SPRINGFIELD GLUE&EMERY Wheel Co. Springfield, MASS.

Water Prevents HEATING THE WORK.

C. W. LE COUNT,

South Norwalk, Conn.

REDUCED PRICE OF LE COUNT'S HEAVY STEEL DOG

No.	Inch.	Price.
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.60
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1-4	.80
9	1 3-8	.95
10	1 1-2	.95
11	1 3-4	1.10
12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$25.60
20 (ext.)	5 1-2	4.00
21 (ext.)	6	5.00

This Dog has a Very Heavy Boss, so that if the thread wears, a Heavier Screw can be substituted.

When ordering, state as above, whether a full set or a set of 13, or small set of 8. Users of these dogs prefer them to any other make.

Le Count's Heavy Steel Dog, With Steel Screws. Lathe Made and Hardened

One Small Set of 8—by 1-4 inches to 20 inch ..... $ 6.25
One Set of 12—by 1-4 in. to 2 in. continued by 1-4 in. to 4 in. 12.00

THE HANCOCK INSPIRATOR.

THE STANDARD

BOILER FEEDER FOR ALL CLASSES OF BOILERS.

OVER 85,000 IN USE.

Send for Circulars and Price Lists.

THE HANCOCK INSPIRATOR CO.

OFFICE, 33 INDIA WHARF, BOSTON, MASS.

THE NEW "GRESHAM" PATENT AUTOMATIC RE-STARTING INJECTOR

"Invaluable for use in Traction, Farm, Portable Marine and Stationary Boilers of all kinds. No handles required. Water supply very difficult to break. Capability of restarting automatically, immediately after interruption to feed from any cause."

SEND FOR CATALOGUE. **RELIABLE AND CHEAP.**

Sole Manufacturers in the United States & Canada,

NATHAN MANUFACTURING CO.

92 & 94 LIBERTY ST., NEW YORK.

WHO USE

—THE—

BEAUDRY HAMMER?

Colwell Iron Works, New York, N.Y.
Rand Drill Co., " "
Iron Clad Mfg. Co., " "
City of Brooklyn Fire Dept. and Repair Shops, N. Y.
Madden & Cockayne File Co., Middletown, N. Y.
Wheeler, Madden & Clemson Mfg. Co., N. Y.
Eames Vacuum Brake Co., Watertown, N. Y.
U. S. Government (Watervliet Arsenal), West Troy, N. Y.
Buffalo Hammer Co., Buffalo, N. Y.
N. Y. L. E. & Western R. R., Hornellsville, N. Y.
Newburgh, Dutchess & Conn. R. R., Matteawan, N. Y.
M. E. Brown & Co., Syracuse, N. Y.
R. D. Wood & Co., Philadelphia, Pa.
The J. Barton Smith Co., Phila., Pa.
Johnson Steel Street Rail Co., Johnstown, Pa.
Ajax Forge Co., Chicago, Ills.
Wm. Deering & Co., Chicago, Ills.
Emerson, Talcott & Co., Rockford, Ills.
Milburn Mfg. Co., St. Louis, Mo.
Gerst Bros. Mfg. Co., St. Louis, Mo.
Benj. Buckley's Sons, Paterson, N. J.
Stanley Mfg. Co., Lawrence, Mass.
John Russell Cutlery Co., Turners Falls, Mass.
Goodell Cutlery Co., Antrim, N. H.
Boston Bridge Works, Boston, Mass.
A. J. Wilkinson, & Co., Boston, Mass.
Atlantic Works, Boston, Mass.
Bisbee, Endicott & Co., Boston, Mass.
Millers Falls Co., Millers Falls, Mass.
Granite Hames Works, Sunapee, N. H.
Kalamazoo R. R. Vel. Co., Kalamazoo, Mich.
H. C. Pingree, Rockport, Mass.
Ellrich, Hdw. Mfg. Co. Plantsville, Conn.
C. F. Swift & Co., Chicago, Ills.

AND MANY OTHERS.

P.H. & F.M. ROOTS,

Connersville, Indiana,

MANUFACTURERS OF

PORTABLE FORGES, TUYERE IRONS, ETC.

ROOTS' NEW ACME HAND-BLOWERS.

Slow-speeded, Force-blast. Durable, Compact and Cheap.

Roots' Foundry Blowers, Gas Exhausters, etc.

S. S. TOWNSEND, Gen. Agt. } 22 CORTLANDT ST., NEW YORK.
COOKE & CO., Selling Agts., }

In Writing, Please Mention This Paper.

BOOKS ON ENGINEERING, ETC.

MAHAN'S Moseley's Principles of Engineering, 8vo, cloth	$5 00
MAHAN'S Bresse's Hydraulic Motors, 8vo cloth	2 50
MERRIMAN'S Introduction to Geodesy, 12mo, cloth	1 50
NICHOLS' Water Supply, 8vo, cloth	2 50
SEARLES' Field Engineering, 12mo, mor. flap	3 00
SEARLES' The Railroad Spiral, 12mo, mor. flap	1 50
THURSTON'S Materials of Engineering Construction, Vol. 1, 8vo, cloth	3 50
THURSTON'S Materials of Engineering, Vol. 2, 8vo, cloth	5 00
THURSTON'S Materials of Engineering, Vol. 3. Alloys of Metals, strength of, etc., 8vo, cloth	4 00
THURSTON'S Materials of Construction, 8vo, cloth	5 00
TRAUTWINE'S Civil Engineer's Pocket Book with flaps	5 00
TRAUTWINE'S Laying Out Curves for Railroads, 12mo, flaps	2 50

John Wiley & Sons, 15 Astor Place, New York.

Catalogues and Circulars Gratis.

Ejectors for Raising Water

From PONDS, TANKS, QUARRIES, MINES, EXCAVATIONS, ETC.

Also, as BILGE PUMPS FOR VESSELS.

PRICE LIST.

CAPACITY PER HOUR IN GALLONS.	PRICE.	SUCTION AND DISCHARGE PIPE.	STEAM PIPE.
500	$8 00	¾ in.	½ in.
800	10 00	1 "	¾ "
1200	15 00	1½ "	1 "
1700	20 00	1½ "	1¼ "
3000	24 00	2 "	1½ "

A. ALLER, 109 Liberty Street, New York.

ASBESTOS ROOFING

FIRE AND WATER-PROOF BUILDING FELT, FIRE-PROOF PAINTS, STEAM PACKINGS, BOILER COVERINGS, ETC.

Samples and descriptive Price List free by mail.

H. W. JOHNS MFG. CO., 87 MAIDEN LANE, N. Y.

CHICAGO, PHILADELPHIA, LONDON.

J. WENDELL COLE, M. E.

Manager of Pennsylvania Southern Lake regions and the Northwest for

DETROIT EMERY WHEEL CO.

Address, Box 84, Columbus, O., or P. O. Box 152 Chicago.

Hart's Corundum-Emery Wheels.

STEWART'S READY ROOFING

PATENT

For ROOFS OF ALL DESCRIPTIONS, steep or flat, can be applied by ordinary workmen having no previous experience. Send for Samples and Illustrated Pamphlet. Address

W. H. STEWART,
74 Cortlandt Street, New York.

IRON FIBRE PAINT, for Roofs and Factory and Farm Buildings.

BEMENT, MILES & CO.

PHILADELPHIA, PA.

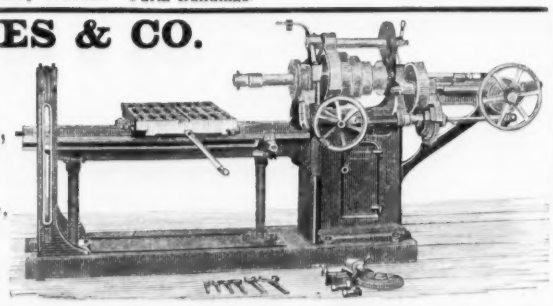
BUILDERS OF

Metal-Working Machine Tools,

FOR

RAILROAD SHOPS,

Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.



MACHINE SHOP & FOUNDRY FOR SALE

The only machine shop and foundry in Owosso, Mich., a place of 5,000, on three lines of R. R. Will be sold at a bargain on easy terms. Address, W. A. Osborn, Box 514, Millbury, Mass.

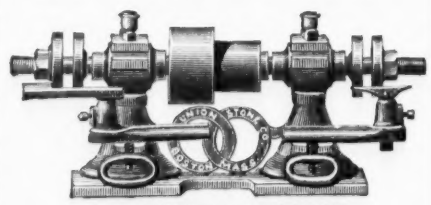
ECONOMICAL STEAM BOILERS

A SPECIALTY.

SEND FOR PRICES. Pond Engineering Co. ST. LOUIS, MO.

UNION STONE CO.,

38 & 40 Hawley St., Boston, Mass.



NO. 1 GRINDING MACHINE.

Has 1 in. Arbor. Takes Emery Wheels to 14" diameter. Is specially adapted to grinding tools and light work of similar character.

We Manufacture Grinding Machinery and Emery Wheels for all classes of Work.

Diamond Tools and Emery-wheel Dressers

FOR REMOVING GLAZE, AND SHAPING THE FACE OF WHEELS, AS REQUIRED.

CATALOGUE ON APPLICATION.

THE

Slate Sensitive Drill

Adapted to rapid work with small drills. Its extreme sensitiveness prevents clogging and breakage of drills. Has a switching table with attachment for center drilling. Instantly adjustable to different lengths of work. Over 200 already in use. Send for circular.

DWIGHT SLATE,

Hartford, Conn.

WORTHINGTON PUMPING MACHINER

HENRY R. WORTHINGTON,

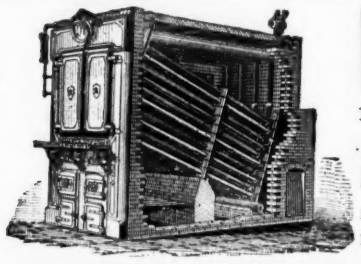
NEW YORK,

Boston, Pittsburgh, Chicago, Cleveland, St. Louis, San Francisco.

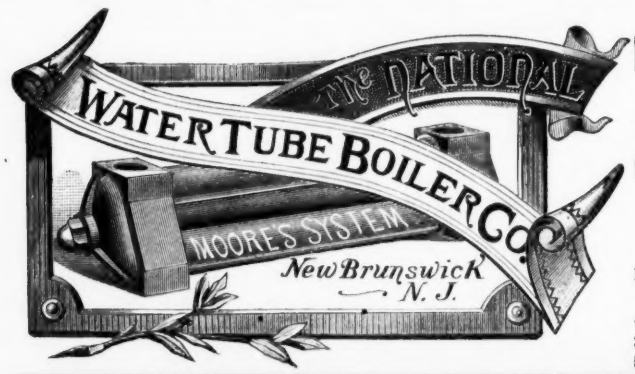
SEND FOR Illustrated Catalogue.

SAFE ECONOMICAL DURABLE
HARRISON SAFETY BOILER WORKS.
BOILERS
PHILADELPHIA. PA.
MERITS PROVEN 20 YEARS RECORD

"STEAM" A VALUABLE BOOK for EVERY STEAM USER AND ENGINEER
PUBLISHED FOR FREE DISTRIBUTION, BY
THE BABCOCK & WILCOX CO.
Manufacturers of
WATER-TUBE BOILERS,
107 Hope St., GLASGOW. *30 Cortlandt St., NEW YORK.*



ROOT'S NEW WATER-TUBE STEAM BOILER
SAFE! ECONOMICAL! DURABLE
FOR ILLUSTRATED CATALOGUE OF NEW BOILER, ADDRESS,
ABENDROTH & ROOT MANUFG. CO.
—*28 CLIFF STREET, NEW YORK.*—
SELLING AGENTS.
DANIEL KELLY, 61 N. 7th Street, Philadelphia, Pa.
A. S. FISKE, 48 Johnston Building, Cincinnati, Ohio.
R. L. WEEKS, 151 Griswold Street, Detroit, Michigan.
WM. H. SMITH, 5 Custom House Street, Providence, R. I.



—OUR—
WATER-TUBE BOILERS
ARE
UNSURPASSED
FOR
SAFETY, ECONOMY AND DURABILITY.
MAIN OFFICE,
New Brunswick, N. J.
BRANCHES:
49 NORTH 7th St., Philadelphia.
36 CORTLANDT ST., New York.
50 OLIVER ST., - Boston.

BRIDGEPORT BOILER WORKS.
BRIDGEPORT CONN.
SEE THE IMPROVEMENTS IN STEAM BOILERS, BOILER FRONTS, BOILER FURNACES, AND FEED WATER HEATERS MADE AT THESE WORKS BEFORE BUYING STEAM PLANT. SEND FOR HISTORIES OF STEAM BOILERS AND FFED WATER HEATERS (FREE) ON MENTIONING THIS PAPER. WM. LOWE.

NEWBURGH STEAM BOILER WORKS. P. DELANY.
NEWBURGH, N.Y.
MANUFACTURER OF
STEAM BOILERS OF EVERY DESCRIPTION
CARRY A LINE OF BOILERS IN STOCK FOR IMMEDIATE DELIVERY.

FLUOR SPAR
THE BEST
FOUNDRY FLUX
A natural product taken from our own mines. Unlike any of the artificial compounds or manufactured products heretofore on the market. We guarantee its success if directions are followed, or ask no pay. Only 8 or 10 pounds to the ton of iron required to purify the iron, and will more than pay for itself in keeping the cupola clean. The best flux for foundry work; also used in reduction and refining of silver, copper and lead. Used by glass manufacturers in making opaque ware. Used by chemists in making hydro-fluoric acid for etching ornamented glass. Can be used in manufacturing steel by the basic process
THE EVANSVILLE LEAD AND SPAR MINING CO.
Successors to B. BURBANK & CO.
Send for circular, prices and experience of users. EVANSVILLE, IND.

SEBASTIAN, MAY & COMPANY'S
Improved Screw Cutting
Foot or Power Lathes

Catalogue of Lathes, Drill Presses and Machinists' Tools and Supplies mailed on application. Lathes on Trial.
167 W. Second St., Cincinnati, O.

THOS. H. DALLETT & CO.
13th & Buttonwood Sts., PHILA., PA.
MANUFACTURERS OF
PATENT
Portable Drilling Machines,
VERTICAL DRILLS,
Radial Drills, Multiple Drills,
HAND DRILLS.
Send for Illustrated Catalogue.

A. J. WILKINSON & CO.,
BOSTON, MASS.,
Makers of the most complete assortment of
Micrometer Calipers and Fine Measuring Tools,
to be found in the world.
Send for Illustrated Catalogue with Tables.

A FAIR OFFER.
If you will put a JENKINS BROS. VALVE, on the worst place you can find, where you cannot keep other valves tight, and if it is not perfectly tight or does not hold Steam, Oils, Acids, or other fluids longer than any other Valve, you may return it, and your money will be refunded.
IF YOU WANT THE BEST, CALL FOR "JENKINS BROS." VALVES.
JENKINS BROS.,
71 John St., New York. 13 So. Fourth St., Phila. 79 Kilby St., Boston.

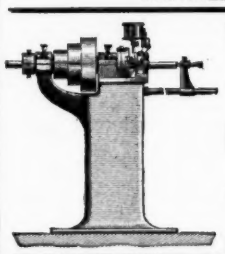
Oneida Steam Engine & Foundry Co., Oneida, N. Y.
Manufacturers of all kinds of LATHE —AND— DRILL CHUCKS
Under Westcott's Patent.
SEND FOR CATALOGUE.

Capacity Little Giant Improved.		
No. 00.	holds 0 to	1/4 inch.
" 0	" 0 to	3/8 "
" 1	" 0 to	5/8 "
" 2	" 0 to	1 "
" 2½	" 0 to	1 "

The United States Mitis Company,
26 BROADWAY, NEW YORK.
Is prepared to issue licenses for the use of patents covering processes for the production of "Mitis Castings" in wrought iron and steel, and furnaces for melting and heating.
"Mitis" Castings retain in every respect all the valuable qualities of the wrought iron and steel (scrap) from which they are made. Do not require annealing. Can be welded and worked under the hammer as well as the raw material.
W. F. DURFEE, General Manager.

THE NATIONAL
FEED WATER
HEATER.
A brass coil heater supplying feed water at 210° to 212° Fahrenheit by use of exhaust steam Our prices are low and reasonable, and we aim to supply the *cheapest, best and most effective Heater in the market.* Sixteen sizes. 10 H.P., $20; 100 H. P., $150; 500 H. P., $600. Iron, Brass and Copper Coils and Bends made to order. Circulars and price lists sent on application.
National Pipe Bending Co.
NEW HAVEN, Conn.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.



William Barker & Co.
Manufacturers of
IRON AND BRASS
—WORKING—
MACHINERY
140 & 142 E. Sixth Street,
N'r Culvert, Cincinnati, O.
Send for circulars and prices.

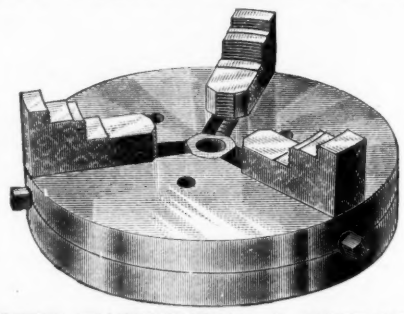
Lubricate Your Engine Cylinders perfectly, gain power and save oil by using our Patent Automatic Sight Feed Lubricators, showing oil as it enters, drop by drop.

The Seibert Cylinder Oil Cup Co.
I. A. ROGERS, Agent for New York.
19 John Street, New York.

NEW ENGINEERS' WRENCH.

Bolster prevents screw from turning. Ferrule is long, solid and strongly riveted, nut is deeply corrugated, making screw turn easily.
G. T. MOORE, 112 Chambers Street, New York.

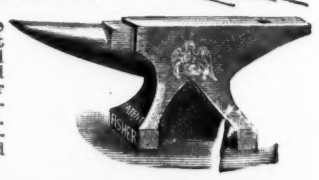
ESTABLISHED 1851.
THE HORTON LATHE CHUCK.



THE E. HORTON & SON CO.
Canal St., Windsor Locks, Conn., U. S. A.

EAGLE ANVIL WORKS,
Trenton, N. J.

The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.
Send for Circulars.



The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.

WELDLESS STEEL TUBES
QUICK OPENING GATE VALVE
COLD DRAWN
SMOOTH INSIDE & OUT.
JOHN S. LENG. 4 Fletcher St N.Y.

"THE SWEETLAND CHUCK" MANUF'D BY THE HOGGSON & PETTIS MF'G. Co NEW HAVEN CONN. U.S.A.
MACHINERY, TOOLS and SUPPLIES.
Complete Outfits for
MACHINISTS, BLACKSMITHS, MODEL MAKERS, JEWELERS, ETC.
Lathes, Planers, Shapers, Drill Presses, Emery Grinders, Milling Machines, Bolts, Screws, Washers, Belting, Packing, Waste, Twist Drills, Taps, Reamers, Cold Rolled Shafting, Hangers, Files.
SEND FOR ILLUSTRATED PRICE LIST OF METAL-WORKERS' TOOLS, ALSO WOOD-WORKERS'.
TALLMAN & McFADDEN, 1025 MARKET STREET, PHILADELPHIA.

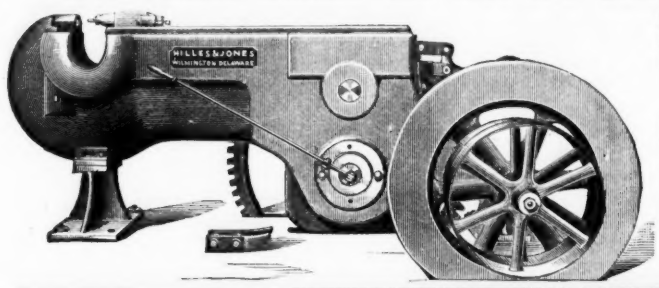
WHY THIS IS PUT HERE!
For the reason that if you are interested in raising water or other liquids by steam power, we wish to call your attention to the
NEW PULSOMETER,
THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER.
More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.
Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.
PULSOMETER STEAM PUMP CO., 83 JOHN STREET, N. Y.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.
Manufacturers of Morse Patent Straight-Lip Increase Twist Drills.

SOLID AND SHELL REAMERS, BEACH'S PATENT SELF-CENTERING CHUCK, BIT STOCK DRILLS, DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

Horizontal Flange Punch

FOR BOILER MAKERS' AND IRON SHIP BUILDERS' USE.



Punches, Flanges of all shapes, and Bent Angle Iron from either side.

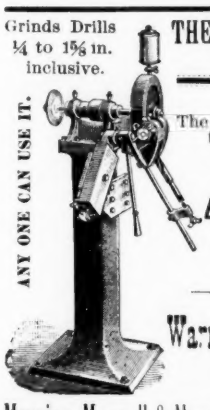
FIVE SIZES.

Depth of Jaws from 6" to 42".

MADE BY

HILLES & JONES,
Wilmington, Del.

Grinds Drills ¼ to 1⅝ in. inclusive.



ANY ONE CAN USE IT.

THE HOUGH TWIST DRILL — GRINDER —

The SPECIAL CLAIMS made for this Tool are its

Simplicity, Ease of Operation, Low Price.

—MANUFACTURED BY—

Warner & Hough Machine Co.
ST. PAUL, MINN.

Manning, Maxwell & Moore, 111 Liberty St., New York. | Tallman & McFadden, 1025 Market St., Phila.

DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.

PECK'S PAT. DROP PRESS.
BEECHER & PECK, NEW HAVEN CONN.

MACHINERY
For Reducing and Pointing Wire.

Especially adapted to pointing wire rods and wire for drawing.

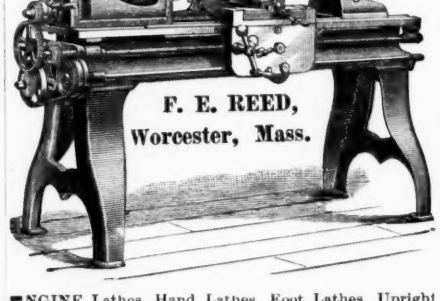
For Machines or information, address the manufacturer.

S. W. GOODYEAR, Waterbury, Ct.

SLOAN. CHACE & CO.,

SEND FOR CATALOGUE.

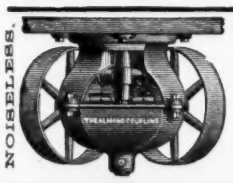
289 to 293 Washington St.
NEWARK, N. J.
MAKERS OF
MACHINISTS BENCH LATHES,
also
WATCH & SPECIAL MACHINERY



F. E. REED,
Worcester, Mass.

ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, Manning, Maxwell & Moore, 111 Liberty Street, New York.

NOISELESS.



The Almond Coupling.

A new quarter turn motion to replace quarter turn belts and bevel gears.

T. R. ALMOND, Mfr.,
83 & 85 Washington Street,
BROOKLYN, N. Y.

L. S. STARRETT,
Manufacturer of
FINE TOOLS
ATHOL, MASS.
SEND FOR FULL LIST.

CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK.

UNIVERSAL RADIAL AND RADIAL DRILLING MACHINES
THREE DESIGNS. SIX SIZES.
EMBODY ALL DESIRABLE FEATURES
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO
CINCINNATI, O. U.S.A.

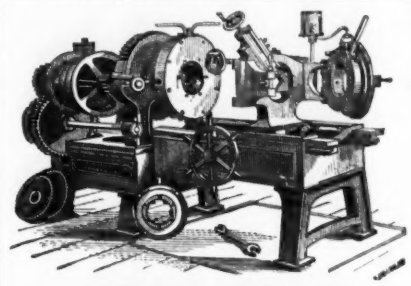
FORBES & CURTIS,
BRIDGEPORT, CONN.
Manufacturers of
The Forbes Pat. Die Stocks,
Power Pipe Cutting and Threading Machines, Cutting-off Machines, Ratchet Drills, Special Machinery, etc., etc.
WRITE FOR CATALOGUE.
Mention Paper.

Established in 1874.
CLEVELAND TWIST DRILL CO.
24 and 26 West Street, Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

The Eaton, Cole & Burnham Co.
Manufacturers of
Pipe Cutting and Threading Machines
OPERATED BY HAND OR POWER.
FITTINGS,
Valves, Pipe, Pipe Tools.

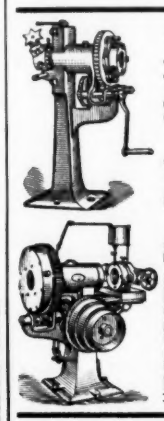
82 & 84 FULTON STREET, NEW YORK.
ALL STYLES OF
Iron and Brass Goods
for STEAM, WATER & GAS.

Ratchet Die Stock with LEADER SCREW and SOLID DIES.
Ratchet is inside body of stock, and cannot be clogged with chips and dirt. Can be readily reversed to back-off thread or cut left-hand thread. Will thread pipe in place. Works in small space.
Factory, Bridgeport, Conn.



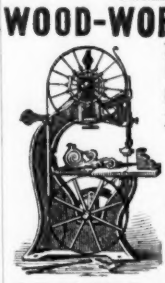
SEND FOR CIRCULAR.

D. SAUNDERS' SONS,
Manufacturers of
Pipe Cutting & Threading Machines
For Pipe, Mill and Steam Fitters' Use.
TAPPING MACHINES,
For Steam Fitting, also
Steam and Gas Fitters' Hand Tools.
YONKERS, N. Y.



"ECLIPSE" Pipe-Cutting Machines
FOR HAND OR POWER.
Don't you have sufficient Pipe-Work about your Mill, Factory, or Shops to make a powerful, convenient and very compact Pipe-Cutting Machine soon pay for itself, providing it could be had at a moderate price? Mention this paper and write us for particulars.
PANCOAST & MAULE,
Philadelphia, Pa.
Made in Three Sizes, Cutting Pipes ¼ to 6 inch.

J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY

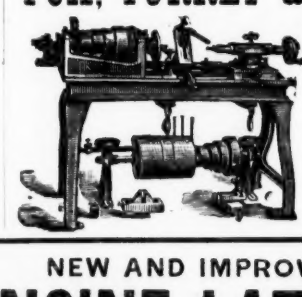


Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.
Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.
V. H. DOANE, Pres't. D. L. LYON, Sec'y.

Barnes' Pat. Upright Drills
20-inch Swing, with both Worm and Lever Feed.

Barnes' Pat Engine Lathe
15-inch swing, 6-foot or 8 foot Bed. These machines are made a specialty in our factory, they have advantages not found in other machines in this line. It will pay parties desiring to purchase, or know more about this class of machines, to send for full description and prices.
W. F. & JOHN BARNES CO.
1995 Main St., Rockford, Ill.

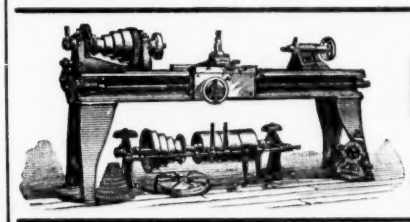
W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, Etc.



SHAPING MACHINES
For Hand and Power, 6", 8" and 10" Stroke.
Adapted to all Classes of Work to their capacity.
CIRCULARS FURNISHED.
BOYNTON & PLUMMER,
Worcester, Mass.

FOX, TURRET & SPEED LATHES AND BRASS FINISHERS' TOOLS,

GAGE MACHINE WORKS,
WATERFORD, NEW YORK.



NEW AND IMPROVED
ENGINE LATHES.
THE MULLER MACHINE TOOL CO.
179 West Pearl St., CINCINNATI, OHIO.
Send for Cuts and Prices.

Patent Flexible Back Hack Saw for Machinists' Use.

Made of best Band Steel. The teeth only are hardened by an entirely new process, the back remaining soft and flexible. Warranted not to break. Send for sample and circular. Endorsed by the Pratt & Whitney Co., John Henney, Jr., Supt. Motive Power, N. Y. & H. & R. and others.
HENRY G. THOMPSON & SONS,
New Haven, Conn. | 51 Leonard St., N. Y.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS.
JAS. HUNTER & SON,
North Adams, Mass.

BEVEL GEARS,

Cut Theoretically Correct.
For particulars and estimates apply to
BREHMER BROS.
Machinists,
440 N. 12th St., Philadelphia, Pa.

BOILER FEED PUMP

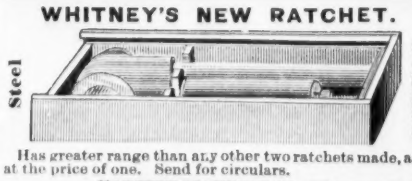
MADE BY
M. R. MUCKLE, Jr. & CO.
PHILADELPHIA,
SIZES TO SUIT STEAM PLANTS, UP TO 300 H. P.
Send For CirculaR

THE ELLIOTT DRILL PRESS
(Which always was good.)
Has Recently Been Much Improved.
Send for Particulars.
STERLING ELLIOTT, NEWTON, MASS.

PATENTS E. B. STOCKING, ATTY
Opp. Pat. Of. Washington, D. C.
Send sketch for free report as to patentability and new book on Patents.

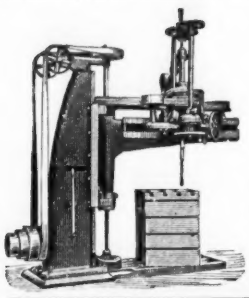
P. BLAISDELL & CO.
Manufacturers of
Machinists' Tools,
WORCESTER, MASS.

WHITNEY'S NEW RATCHET.



Has greater range than any other two ratchets made, and at the price of one. Send for circulars.
VARIETY MACHINE CO., Warsaw, N. Y.

USE THE *Mason Reducing Valve* FOR CONSTANT PRESSURE
Address, MASON REGULATOR CO.
22 Central Street, Boston, Mass.



WILLIAM SELLERS & CO. INCORPORATED,

Engineers and Manufacturers of

IMPROVED MACHINE TOOLS FOR WORKING IRON AND STEEL

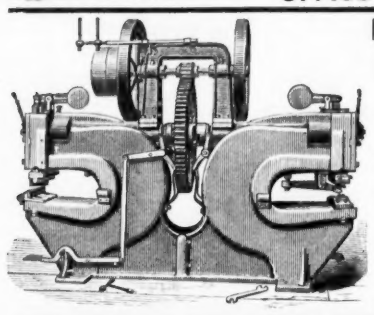
STEAM HAMMERS, PUNCHES and SHEARS, LATHES, PLANERS, BENDING ROLLS, BORING and TURNING MILLS, DRILL and TOOL GRINDERS, Etc., Etc.

SHAFTING, PULLEYS, HANGERS, COUPLINGS, Etc.

Improved Injectors for Feeding Boilers.

PAMPHLETS, PHOTOTYPES AND PRICES FURNISHED ON APPLICATION TO

OFFICE AND WORKS, PHILADELPHIA, PENN.



THE LONG & ALLSTATTER CO. Hamilton, OHIO

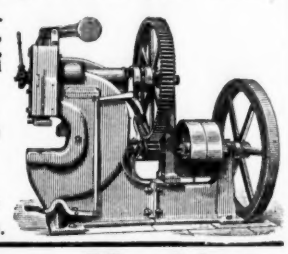
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven

Punches and Shears.

Over 300 Sizes.

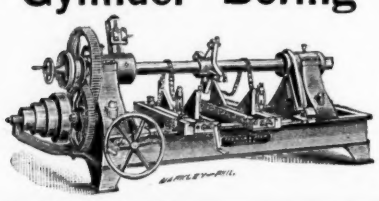
ALSO,

Power Cushioned Hammer.



Send for new Catalogue.

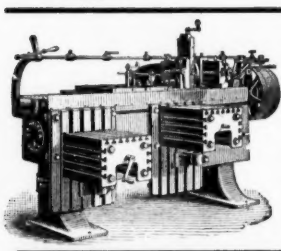
Cylinder Boring and Facing Machine.



Will bore from 8 in. to 22 in. Cylinders, facing off the ends and boring at same time. It is built strong, neat and powerful, and is a valuable machine for Railroad Shops and Steam Engine Builders. Circulars and prices on application.

PEDRICK & AYER,

PHILADELPHIA, PA.



HOYT & BROTHER MANUFACTIURNG COMPANY,

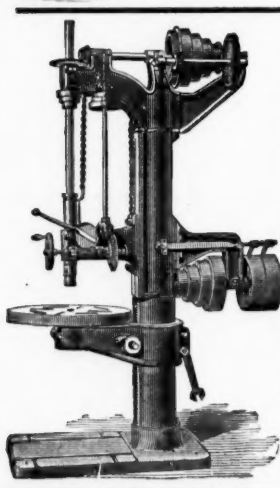
Aurora, Ills., April 17, 1886.

E. A. WALKER,

75 Laurel Street, Philadelphia, Pa.

DEAR SIR:—The Combination Planer we purchased of you the latter part of 1884, is regarded as one of the most satisfactory tools in our shop. Is exceedingly well made and has a wonderful range for work. It gratifies us to add this merited testimonial to your Planer. Yours respectfully,

C. L. HOYT, President.

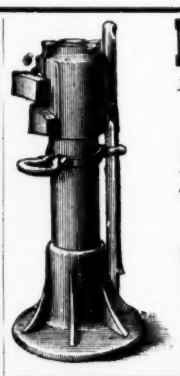


UPRIGHT DRILLS

A SPECIALTY,

ALL SIZES WITH PATENT QUICK RETURN FEED AND ALL MODERN IMPROVEMENTS.

H. BICKFORD, Cincinnati, Ohio.



Hydrostatic Machinery

PRESSES, PUMPS, PUNCHES,

ACCUMULATORS

JACKS, VALVES, FITTINGS,

Vault Elevators, Etc.

WATSON & STILLMAN,

204-210 E. 43d St., New York.

FAY & SCOTT, DEXTER, ME.

MANUFACTURERS OF

WOOD LATHES,

Drill Lathes, Shaping Machines, Milling Machines, Planer Centers, Etc.

SEND FOR CATALOGUE.

New Haven Manf'g Co.

NEW HAVEN, CONN.

IRON-WORKING MACHINERY.

— OUR — NEW CATALOGUE OF TOOLS

and Supplies sent free to any address on receipt of Ten Cents in stamps (for postage).

CHAS. A. STRELINGER & CO., Wood Ave., Detroit, Mich.

THE GARDNER GOVERNOR

Over 45,000 in Use.

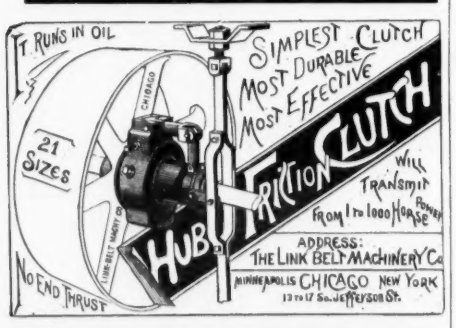
ADAPTED TO EVERY STYLE OF STATIONARY AND PORTABLE STEAM ENGINE.

Warranted to give satisfaction or no sale.

FOR CIRCULARS AND PRICES ADDRESS,

The Gardner Governor Co.,

QUINCY, ILL.



WOOD-WORKING MACHINERY

For Planing Mills, Furniture, Chair and Cabinet Factories, Cabinet Works and General Wood-Working. Send Stamp for Illustrated Catalogue to

Rollstone Machine Co.,

45 WATER ST.,

FITCHBURG, MASS.

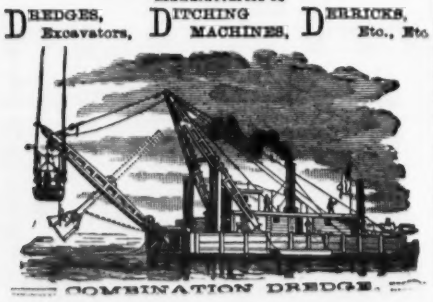
OSGOOD DREDGE CO., - ALBANY, N. Y.

RALPH R. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres.

JOHN K. HOWE, Secretary and Treasurer.

Manufacturers of

DREDGES, Excavators, DITCHING MACHINES, DERRICKS, Etc., Etc.



COMBINATION DREDGE.

Southwark Foundry & Machine Co.

ENGINEERS AND MACHINISTS.

WASHINGTON AVE. AND FIFTH ST., PHILADELPHIA, PA.

PORTER-ALLEN and SOUTHWARK ENGINES, BOILERS AND TANKS,

BLOWING ENGINES, PUMPS, GAS APPARATUS, BESSEMER CONVERTERS, ETC.,

SUGAR MACHINERY, HYDRAULIC MACHINERY, ETC., ETC.

STANDARD PUNCHES FOR

IRON & STEEL PLATES.

Lynde's Pat.

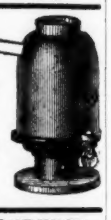
Pop Safety Valves,

Adapted to all Boilers.

J. E. Lonergan & Co.,

Sole Owners and Manuf'rs

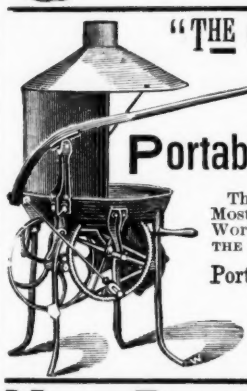
PHILA., PA.



"THE ONLY PERFECT"

BUFFALO

Portable Forges,



The Lightest, Strongest, Most Durable, Easiest Working, and in every way THE BEST

Portable Forge Made.

Buffalo Forge Co.,

BUFFALO, N. Y.

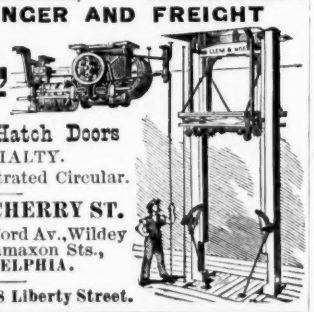
MORSE ELEVATOR WORKS

MORSE, WILLIAMS & CO.,

Successors to CLEM & MORSE, Builders of all Kinds of

PASSENGER AND FREIGHT

Elevators,



Automatic Hatch Doors

A SPECIALTY.

Send for Illustrated Circular.

Office, 411 CHERRY ST.

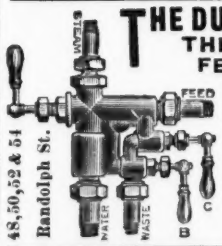
Works, Frankford Av., Wildey and Shackamaxon Sts.,

PHILADELPHIA.

N.Y. Office, 108 Liberty Street.

THE DUPLEX INJECTOR

THE BEST BOILER FEEDER KNOWN.



48, 50, 52 & 54 Randolph St.

Not liable to get out of order. Will lift water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by

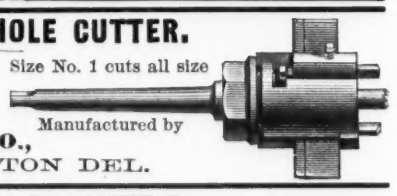
JAMES JENKS & CO.,

Detroit, Mich.

HARRISON'S ADJUSTABLE FLUE-HOLE CUTTER.

An effective labor-saving tool for the boiler shop. holes from 2 to 5 inches inclusive. The cutters proper are forged from ⅝-inch round steel, can be renewed at trifling cost; are easily adjusted and firmly held.

Size No. 1 cuts all size



Manufactured by

REMINGTON & CO.,

WILMINGTON DEL.

THE NEW YORK SUPPLY CO., LIMITED,

SOLE AGENTS FOR THE

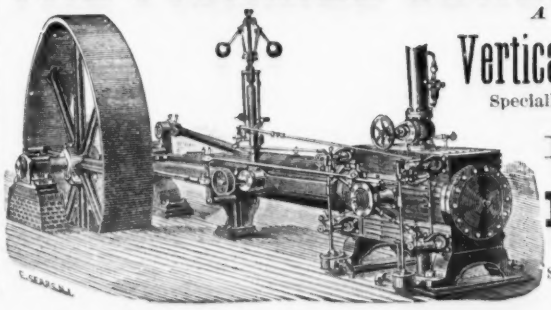
ELLIS THREE-WHEEL PIPE CUTTER.

Engineers, Machinists & Mill Supplies.

50 & 52 JOHN ST., NEW YORK.

THE FISHKILL CORLISS ENGINE.

A FULL LINE OF SIZES.



Vertical Condensing Engines

Specially adapted for and extensively used in large grain elevators.

BOILERS.

Manufactured by the

Fishkill Landing Machine Co.

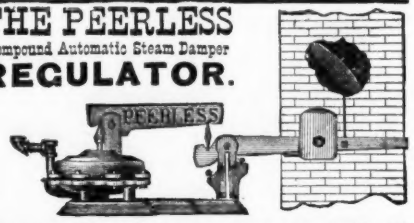
FISHKILL-ON-THE-HUDSON, N. Y.

Send for Catalogue A, containing Illustrated Descriptions and References.

THE PEERLESS

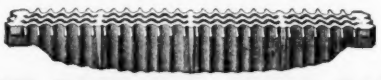
Compound Automatic Steam Damper

REGULATOR.



GUARANTEED THE BEST SAVER OF FUEL IN THE MARKET.

Has been used six years by 700 of the largest mills and firms in the U. S.; not one given out. Always put up by our own mechanics. Warranted to keep in order 5 years. Send for printed testimonial of large users.



THE PEERLESS GRATE BAR.

Warranted not to Warp, and the Most Durable in Use.

American Steam Appliance Co.

W. A. SIMMONS & CO., Sole Agents,

280 Broadway, New York, 22 & 24 N. 4th St., Phila.

MORSE ENGINEERING CO.

306 Union Avenue, Kansas City, Missouri.

GENERAL AGTS. FOR THE SOUTH WEST.

DIXON'S

Graphite Grease

FOR GEARS.

Joseph Dixon Crucible Co.

JERSEY CITY, N. J.

THE SKINNER ENGINE CO.

ERIE, PA.

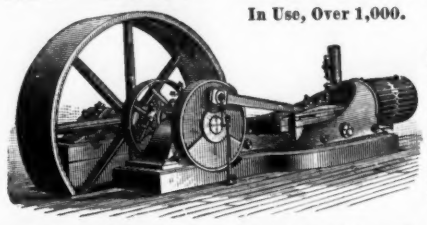
PORTABLE AND STATIONARY

ENGINES and BOILERS

Send for Catalogue and Prices.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.

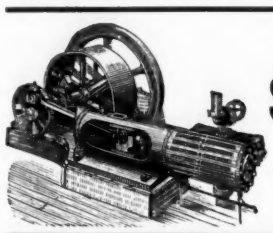


These Engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines, 12 to 100 H P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

SALES AGENTS: W. L. SIMPSON, 70 Astor House, N. Y. { N W. ROBINSON, cor. Clinton & Jackson Sts., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn. PRAY MFG. CO., Minneapolis, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA,

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.



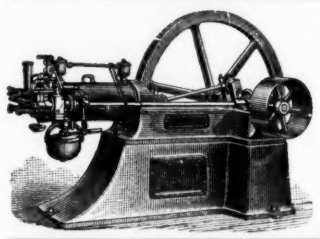
THE BECKETT & McDOWELL MFG. CO.,

STEAM ENGINES, HOISTS, PUMPS,

AND GENERAL MINING MACHINERY.

120 LIBERTY ST., NEW YORK.

☞ SEND FOR ILLUSTRATED CATALOGUE.



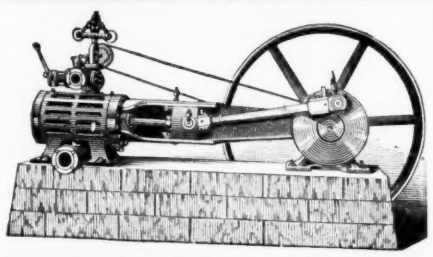
"OTTO" GAS ENGINE WORKS,

SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts. PHILADELPHIA. Branch Office, 130 Washington St. CHICAGO.

OVER 18,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine per Brake-horse-power.



STEARNS MFG. COMPANY,

ERIE, PA.

Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at ERIE, PA.

HOISTING ENGINES.

Of any power and Style. SINGLE AND DOUBLE CYLINDER, with improved patent friction drums, especially adapted for bridge building, dock building, pile driving, coal hoisting, quarries, mines, etc.

J. S. MUNDY, Newark, N. J.

This patent has been sustained in U. S. Courts in New York and N. J.

SECOND-HAND TOOLS FOR SALE by POOLE & HUNT, Baltimore, Md.

1 Planing Machine. Will plane 35in. wide, 27 in. high, and 16 ft. 6 in. long.
1 Planing Machine. Will plane 30 in. wide, 26 in. high, and 5 ft. 6 in. long.
1 Planing Machine. Will plane 24 in. wide, 22 in. high, and 5 feet long.
1 Double Geared Chasing Lathe. Will swing 24 in. dia., 8 ft. 6 in. long.
1 Drill Grinding Machine.
1 Small Punching and Shearing Machine, with fly wheel and clutch starting arrangement.

MACHINERY,

NEW AND SECOND-HAND.

12 in. S., 5 ft. Bed Engine Lathe, New
14 " 5 and 7 ft. Bed Engine Lathe, Bogert new
14 " 5½ ft. " " " Harris, cheap
16 " 6 ft. " " " Ames.
15 " 6 ft. " " " Pratt & Whitney.
17 " 6 ft. " " " Putnam, not screw cutting.
17 " 6', 7' " " Hewes & Phillips.
18 " 8 ft. " " " Fitchburg, g. o.
19 " 10, 12, 14" " " Pond, nearly new.
24 " 20 ft. " " " Ames, new.
29 " 12 ft. " " " Harrisburg.
34 " 12 ft. " " " Harrisburg, good.
16x6 ft. Turret Lathe with chasing bar.
14 in.-20 in. and 33 in. Turret Head Chucking or Screw Machines, Bridgeport.
23 in., 25 in. and 28 in. Drills, Blaisdell, new.
20 in. Drill, Prentice.
20 " " Davis.
Elliott Drill. Slate's Sensitive Drill. Gang Drill.

SHAPERS.

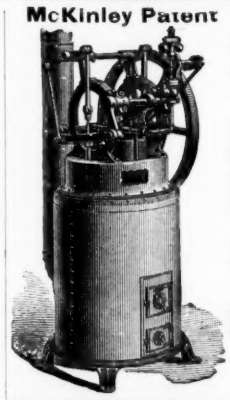
8 in. Gould. 12 in Sellers.
8 in. Boynton & Plummer 15 & 24 in. Wolcott.
24 in. Hendey, 24 in. Bridgeport.

PLANERS.

16x42 in. Bridgeport. 18 in x 3 ft., Wheeler,
24 in x 6 ft., Powell. 24 in x 8 ft. Ames.
26 in. x 6&8 ft., " 22 in x 4 ft ,5 ft. and 6 ft. Powell.
32 in. x 10 ft., Pond 34in. x 10 ft , P. & W.
36 in. Squaring Shear, power, nearly new.
No. 3½ and 5 Press, Stiles
25-40 lb. Bradley Cushioned Hammer.
Lot of miscellaneous Machinery If you do not see what you want, write and state what is required.

E. P. BULLARD, 14 Dey St., New York.

McKinley Patent



Air Engine.

The Best and Cheapest on the Market.

No Steam. No Water. Absolute Safety. No Engineer No Pumps No Gauges. No liability to freeze up No Regulation required.

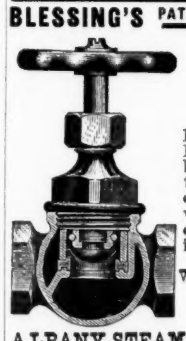
NO EXTRA INSURANCE.

Can be used for any purpose where power is required.

Cheap Fuel. Cheap First Cost.

McKinley Engine Co. 17 Broadway, CINCINNATI, O.

BLESSING'S PATENT RENEWABLE-SEAT



Stop and Check Valves.

The renewable Seats and Discs are cast from the best Phosphor Bronze Metal, which has lasting qualities, double that of the best Steam Metal commonly used in first-class valves. The Seats are simply dropped into place and held in position by bottom of cage.

We also manufacture the Albany Bucket and Gravitating Steam Traps.

ALBANY STEAM TRAP CO., Albany, N.Y.

MACHINERY,

NEW and SECOND-HAND.

LATHES.

One.. 17 in. x 6 ft Forsaith Engine Lathe, 2nd-hand
One.. 22 in. x 10 ft Putnam " "
One.. 18 in x 8 ft. " " "
One.. 18 in. x 12 ft. " " "
One.. 16 in. x 6 ft., Fifield, " "
One.. 20 in. x 8 ft. " " "
One.. 21 in. x 8 ft., " " "
Five No. 3 Plain L. D & Co., Hand Speed Lathe, New
One.. 26 in. x 16 ft., " " Engine Lathe "
Five 13 in-x 5 ft. " " Turret " New
Three No. 1 " " Hand, Fox " "
Four 15 in. L. D & Co. Fox Monitors " "
One.. 12 in. " " " " "
One 19 in. x 8-10-12" " all in A No. 1 order
One.. 19-21 in. x 10 ft Pond Lathe, 2nd-hand
One.. 30 in. x 22 ft New Haven Lathe, "
One.. Gauge Lathe, "

PLANERS.

One.. 22 in. x 22 in x 6 ft. Powell (good as new), 2d-h'd
One.. 30 in x 30in. x 8 ft. Pond, "
One.. 24 in. x 24 x 6 ft Wood & Light " "
One.. 18 in. x 16 x 3 ft. 6 in. Putnam New
One.. 24x24in. x 6 Pease New
One.. 20x20 in x 4 ft. Williams Planer, New
One.. 24x24 in. x 5 ft. Whitcomb " 2nd-hand
One.. 20x20 x 4in. 6 ft. Putnam, "
One.. 20 in. Steptoe Shaper, 2nd-hand
Two 20 in. L. D. & Co. Shapers, New
Two 26 in " " " "
One.. 32 in. " " " "

DRILLS.

Six .. 24 in. Bickford Drills New
One.. 25 in. L. D. & Co., B. G. & S. F. Drill "
Three 20 in. Bickford Lever Drills "
One.. 24 in. Bickford Drill, 2nd-hand
One.. 20 in. L. D. & Co. Lever Drill "
Six .. 20 in. L. D & Co. " " New
Three 28 in. Bickford B. G. & S. F. Drills "
Three 32 in. " " " " "

MISCELLANEOUS.

Two Grant & Bogert Universal Millers, New
One.. Small Valve Miller, "
One.. Sellers Car Wheel Borer, 2nd-hand

☞ (See Advertisement on page 16.)

LODGE, DAVIS & CO.

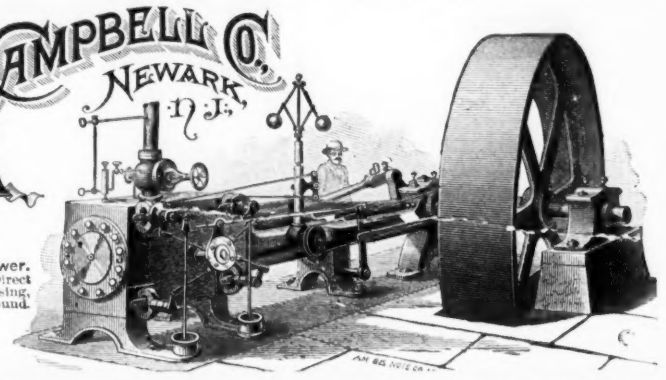
Manufacturers and Dealers, CINCINNATI, OHIO.

The Watts, Campbell Co.,

NEWARK, N. J.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

Sizes varying from 30 to 2000 Horse Power. Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound. Send for Circular.



HEWES & PHILLIPS Iron Works.

IMPROVED

Corliss Engine,

High Pressure,

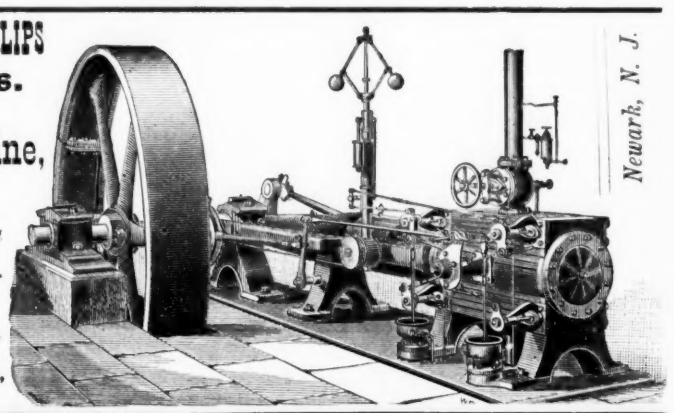
—Condensing—

And Compound

Send for Circular.

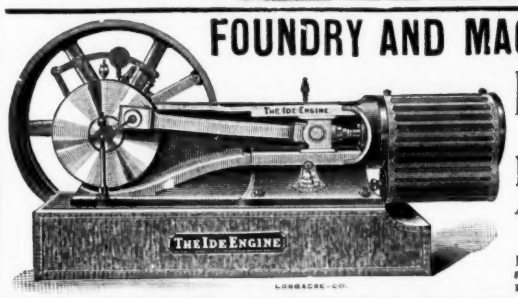
AGENT:

Geo. A. Barnard. (175 Temple Court) 7 Beekman Street, NEW YORK.



Newark, N. J.

FOUNDRY AND MACHINE DEPARTMENT,



HARRISBURG CAR MFG. CO.

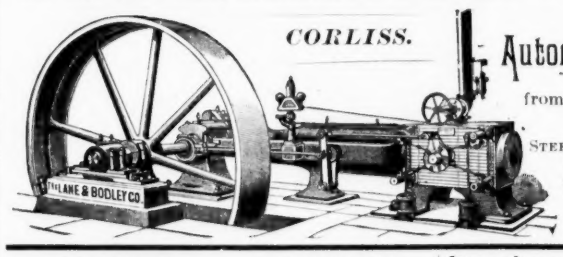
HARRISBURG, PA.

Highest Award Silver Medal AND Diploma

AT FRANKLIN INSTITUTE NOVELTY EXHIBITION, PHILADELPHIA.

We are operating the finest and most successful Electric Light Stations in the world. A change of speed not exceeding one per cent guaranteed, running light and loaded Send for catalogue.

The Lane & Bodley Co.



CORLISS.

MANUFACTURERS OF

Automatic Cut Off Engines,

from heavy patterns and of unexcelled workmanship.

STEEL BOILERS, FEED WATER HEATERS, SHAFTING, PULLEYS & GEARING.

THE LANE & BODLEY CO. East side John, cor. Water, Cincinnati, O.

DRAWING INSTRUMENTS

Send for 72-Page ILLUSTRATED CATALOGUE.

WM. T. COMSTOCK, 6 Astor Place, - New York.

S. Ashton Hand Mfg. Co., Toughkenamon, Pa.

Hand's Twist Drill Grinding Attachment.

Readily attached to any grindstone, emery or cutter-grinder. Grinds right and left hand drills from 3/8" diam. down to smallest sizes made. PRICE, $20.

MACHINISTS' SCALES,

Patent End Graduation.

We invite comparison for accuracy with all others. Every Scale Guaranteed. Send for List.

COFFIN & LEIGHTON, SYRACUSE, N. Y.

PATENT UNIVERSAL SCREW-CUTTING, CENTER, DEPTH, ANGLE AND

TWIST DRILL GAUGE.

J. WYKE & CO.

Fine Machinists' Tools, E, BOSTON, MASS. Send for Circular.

EXTRA HEAVY LATHE

WE ARE MAKING A SPECIALTY OF A 24-INCH LATHE, WITH BED ANY LENGTH DESIRED. THIS LATHE IS DESIGNED FOR SEVERE SERVICE; IT IS THE HEAVIEST OF ITS SIZE EVER PRODUCED, AND THE WORKMANSHIP AS GOOD AS SKILL CAN MAKE IT.

SEND FOR CIRCULAR.

S. S. HEPWORTH & CO., "Glenwood Station," Yonkers, N. Y.

American Twist Drill Company's

PATENT CHUCK JAWS.

Three sizes. Price per set of 4 Jaws, $40, $48, $56. Bolted to lathe face plates, they make best and cheapest chuck in the world. Address orders,

HILL, CLARKE & CO., Boston and St. Louis,
MANNING, MAXWELL & MOORE, N. Y. City,
TALLMAN & McFADDEN, Philadelphia, Pa.,
or WM. BINGHAM & CO., Cleveland, Ohio.

UPRIGHT POWER HAMMER.

This Hammer possesses advantages superior to any other in the market It has neither cylinders, valves or piston rods, consequently repairs are trifling. It takes up less space, less power to drive; strikes much harder and truer blows than hammers with double the weight of ram.

It can be worked to strike good alternate blows on a 3-inch and ¾-inch bar when a 100-pound hammer is used, and can be used on die work to a far greater advantage than any other hammer known. Manufactured by the

E. A. BELDEN CO., Danbury, Conn

SEND FOR SPECIAL LIST.

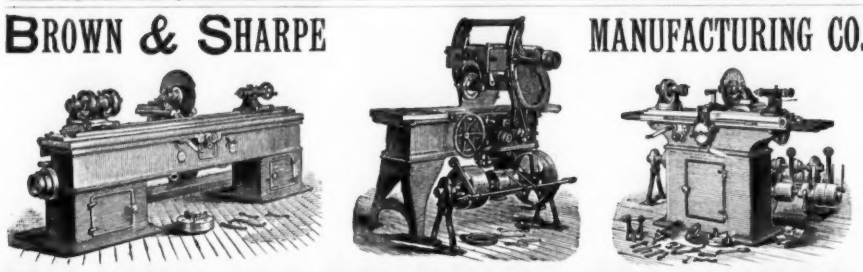
New and Second-hand Machinery.

COLD-ROLLED SHAFTING, HANGERS, PULLEYS, ETC., ETC.

GEORGE PLACE MACHINERY CO.

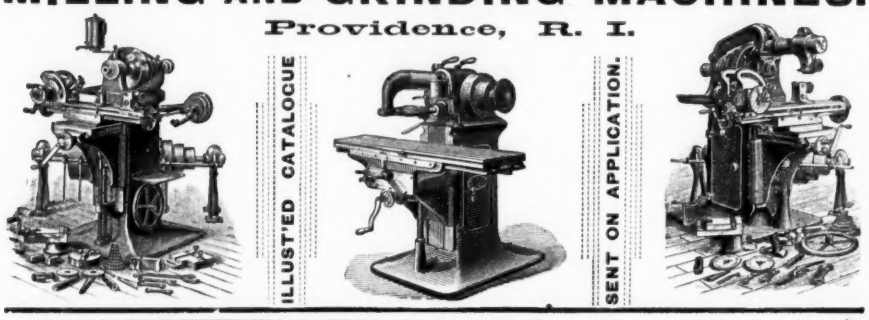
121 Chambers St., New York.

BROWN & SHARPE MANUFACTURING CO.



MILLING AND GRINDING MACHINES.

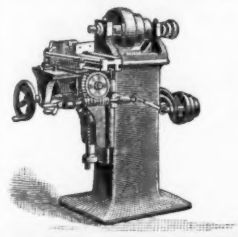
Providence, R. I.



ILLUST'ED CATALOGUE SENT ON APPLICATION.

THE PRATT & WHITNEY CO.

Hartford, Conn.



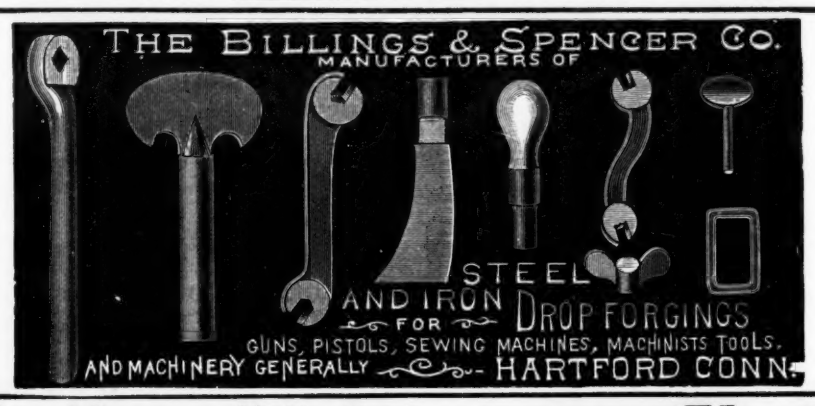
Manufacture Plain Milling Machines, with hand and power feed, of several sizes. Index, double face, vertical face, double spindle and shuttle race Milling Machines. Cam Cutters and Profiling Machines of several kinds. Milling Machines, Vises and Centers. Milling Cutter and Twist Drill Grinding Machines.

RACK AND GEAR CUTTING MACHINES.

KNURLING TOOLS. CUTTERS FOR THE TEETH OF SPUR WHEELS.

THE BILLINGS & SPENCER CO.

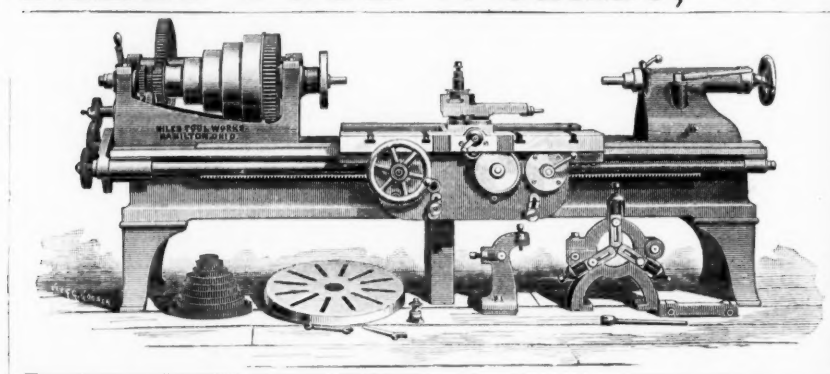
MANUFACTURERS OF



STEEL AND IRON DROP FORGINGS FOR GUNS, PISTOLS, SEWING MACHINES, MACHINISTS TOOLS, AND MACHINERY GENERALLY.

HARTFORD CONN.

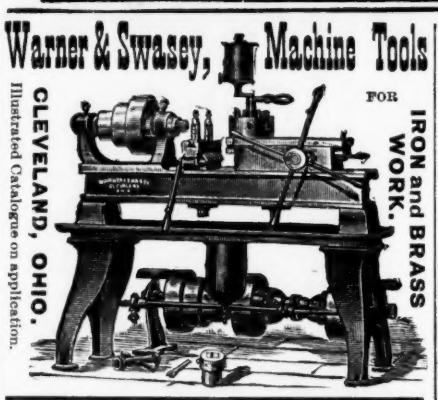
NILES TOOL WORKS, HAMILTON, OHIO.



Lathes, Planers, Shapers, Slotters, Etc.

Warner & Swasey, Machine Tools

FOR IRON and BRASS WORK.



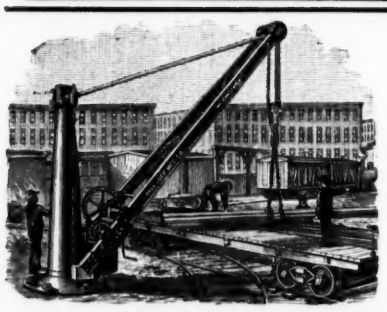
CLEVELAND, OHIO.

Illustrated Catalogue on application.

Engine Lathes, Planers, Drills, &c.

POND MACHINE TOOL CO., SUCCESSORS TO DAVID W. POND,

New Designs, Quick Delivery. Great Variety. Worcester, Mass.



PILLAR CRANE

PILLAR CRANES,

ANY CAPACITY.

Descriptive Circulars on application, and full Specification and Tender promptly submitted on receipt of capacity, height of hoist and effective radius desired. Standard sizes in stock.

SOLE MAKERS,

THE YALE & TOWNE MFG. CO.

STAMFORD, CONNECTICUT.

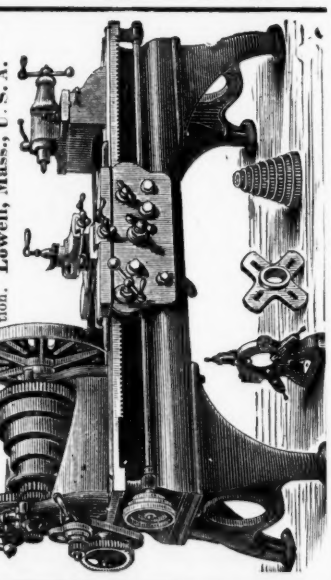
NEW YORK — CHICAGO — PHILADELPHIA — BOSTON.

Catalogues on application.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 46 in. swing. Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.



HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

HARTFORD, CONN.

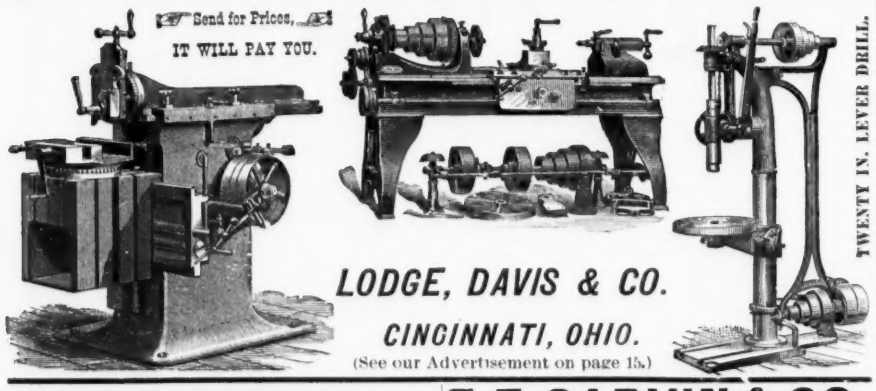
J. M. ALLEN, PRESIDENT.

W. B. FRANKLIN, VICE-PRESIDENT.

J. B. PIERCE, SECRETARY.

SHAPERS, ENGINE LATHES AND DRILLS

Send for Prices, IT WILL PAY YOU.



TWENTY IN. LEVER DRILL.

LODGE, DAVIS & CO.

CINCINNATI, OHIO.

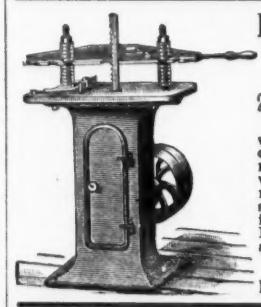
(See our Advertisement on page 15.)

GEAR WHEELS & GEAR CUTTING.

Send for Catalogue D.

GEORGE B. GRANT,

666 Beverly Street, Boston.



KEY-SEATING MACHINES AND 20-in. Drills a Specialty.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key-Seating Machines and 20-inch Drills. Send for Photo. and Catalogue.

W. P. DAVIS,

NORTH BLOOMFIELD, N. Y.

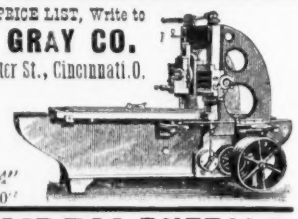
For New Reduced PRICE LIST, Write to

THE G. A. GRAY CO.

Sycamore & Webster St., Cincinnati, O.

Lathes, 17 in. 20 in.

Planers, 24"x24" 30"x30"



E. GOULD & EBERHARDT,

FIRST-CLASS PLANERS.

RETURNS OVER 100 FEET PER MINUTE.

97 to 113 N. J. R. R. AVENUE, NEWARK, N. J.

THE BROWN COTTON GIN CO.,

New London, Conn.,

Sept. 23, 1882.

Gentlemen:—In regard to the 26 in. x 26 in. x 8 ft. planer bought of yo , some time ago, it gives us pleasure to say that it is the best planer we ever saw. The man we have on it says it "Takes the cake," being the best he has run during the thirty years he has been running planers. We are well pleased with our purchase, and no other planer would fill our orders, and we will have no other.

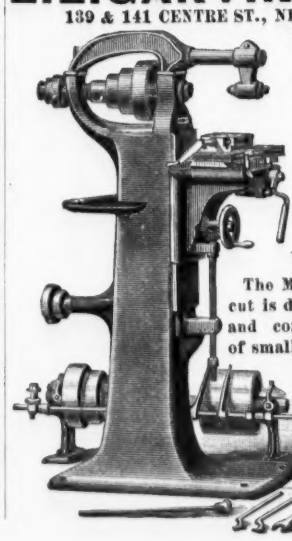
ED. T. BROWN, Treas.

E. E. CARVIN & CO.

139 & 141 CENTRE ST., NEW YORK,

Manufacturers of MACHINISTS' TOOLS

Small Automatic Miller, WITH ARM.



The Machine shown in cut is designed for rapid and convenient milling of small work.

Send for Catalogue.

THE BUFFALO STEEL FOUNDRY, BUFFALO, N. Y.

ORDERS AND CORRESPONDENCE SOLICITED.

PRATT & LETCHWORTH, Proprietors.

The Stiles Machinist Tool Grinder.

FOR GRINDING LATHE, PLANER AND OTHER TOOLS,

—MANUFACTURED BY—

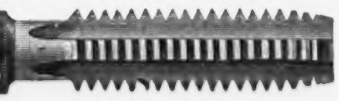
THE STILES & PARKER PRESS CO.

MIDDLETOWN, CONN.

Branch Works and Office:

203, 205, 207 Centre Street, corner of Howard, New York.

J. M. CARPENTER PAWTUCKET, R. I.



Manufacturer of TAPS AND DIES